SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, SEPTEMBER 29, 1899.

CONTENTS:

The Perception of Horizontal and of Vertical Lines (with Plate IV.): PROFESSOR B. O. PEIRCE.. 425
The American Association for the Advancement of Science:—
The Devonian System in Canada (II): J. F. WHITEAVES.. 430
Section B.—Physics: PROFESSOR WILLIAM HALLOCK.. 438
Section I.—Social and Economic Science: PROFESSOR C. M. WOODWARD.. 442
The American Mathematical Society: PROFESSOR THOMAS F. HOLGATE.. 445
The Work of Foreign Museums: F. A. L.. 446
Robert Wilhelm Bunsen: PROFESSOR JAS. LEWIS HOWE.. 447
Scientific Books:—
The Anatomy of the Frog: PROFESSOR J. S. KINGSLEY. *Fischer on Protoplasm:* DR. D. T. MACDOUGAL. *Birch's Practical Physiology, Moore's Elementary Physiology:* PROFESSOR FREDERIC S. LEE. *Minet's Analyses Electrolytiques:* PROFESSOR EDGAR F. SMITH. *Books Received*.. 451
Scientific Journals and Articles.. 454
Societies and Academies:—
The Washington Botanical Club: DR. CHARLES LOUIS POLLARD.. 455
Discussion and Correspondence:—
On the Definition of Geological Terranes: DR. CHARLES R. KEYES.. 456
Zoological Notes: F. A. L.. 458
Recent Zoo-paleontology: H. F. O.. 458
International Congress of Physics.. 459
The Chemical Composition of American Food Materials.. 461
Scientific Notes and News.. 462
University and Educational News.. 464

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor J. McKeen Cattell, Garrison-on-Hudson, N. Y.

THE PERCEPTION OF HORIZONTAL AND OF VERTICAL LINES.

ALMOST every person is occasionally called on to decide 'by the eye' whether some straight line is horizontal or some other line vertical. It usually happens, as, for instance, when one has to set a picture straight on the wall of a room, that the judgment is helped by the presence, in the neighborhood, of other lines, known to be nearly horizontal or vertical, but sometimes all standards are lacking and then the decision is a little more difficult to make.

In order to find out whether such training as a student of physics gets from several years of laboratory work is likely to improve his judgment in such matters as these, and whether astigmatism affects the results materially, I have experimented in the Jefferson Physical Laboratory upon forty persons who kindly consented to make observations for me.

We used two very simple pieces of apparatus. One of these is a fixed horizontal telescope, the eye piece of which can turn freely in its tube. The eye piece carries a single cross hair within, and a large sheet brass disc coaxial with the telescope without. This disc serves as an eye screen, and carries, on the side away from the observer, a divided circle which has a fixed reading microscope. The observer, sitting in a chair before the instrument, with eyes screened from a view of extraneous objects, turns the disc while

looking through the telescope with one eye, until the cross hair, which turns with the disc, seems to be vertical, or horizontal, as the case may be. A piece of ground glass in front of the object glass allows light to have access to the inside of the telescope, but keeps out all disturbing images. An assistant then reads off on the scale, and records, the deviation from verticality or horizontality, and a new setting is made. The mean of a dozen settings, ranging in the cases of some persons over as much as two degrees, suffices to show whether the observer has a decided bias and to measure it fairly well, if it exists. The subjoined table (I) gives the results of the observations of ten persons, five of whom are instructors in Harvard University. The last observer in the list is a lady. The first two and the seventh observers are astigmatic. The first two columns give in degrees the means of the deviations from level of a number of horizontal settings of the cross hair made with the left eye and the right eye respectively. The next two columns give corresponding means of vertical settings. In all the cases the positive sign implies a rotation from the correct position in clockwise direction. The horizontal determinations of all the observers except one, illustrate a fact, familiar to some astronomers and physicists, that a cross hair which seems level to the right eye of a person generally needs to be rotated slightly in counter-clockwise direction to suit the left eye. The third line of the third column shows the only large bias that I have found. In a large number of cases, as the table shows, the deviation of the mean was practically nothing. When the ground glass in front of the object glass was removed, a plumb line made of silk fibre appeared in the field of the telescope, and many settings have been made, by different persons who have used this apparatus, which could not be in the least improved when the plumb line became visible. Observations made by the same person on different days show slight differences in general, but unusual fatigue sometimes introduces a temporary bias of half a degree or perhaps a little more. I have not been able to discover from settings made with unscreened eyes in a room in which many horizontal and vertical lines may be seen, that observers are much affected by after images, or by outside standards not nearly superposed upon the line to be set, provided that the head is erect.

Table I.

Observer.	Mean deviation of horizontal settings made with		Mean deviation of vertical settings made with	
	the left eye.	the right eye.	the left eye.	the righ eye.
1	+0°.6	+1°.2	−2°.3	+0°.2
2	+0 .1	−0 .9	−0 .2	−1 .4
3	−1 .5	+0 .8	−5 .2	−0 .5
4	−0 .2	+0 .6	±0 .0	+0 .6
5	+0 .1	+0 .8	±0 .0	+0 .8
6	−0 .6	+0 .6	−0 .2	+0 .1
7	−0 .1	+0 .8	+0 .4	+0 .5
8	−0 .2	+0 .7	−0 .2	−0 .1
9	±0 .0	+0 .4	−0 .2	−0 .3
10	−0 .7	±0 .0	±0 .0	±0 .0

To find out whether the accuracy of the results depended mainly upon the horizontality of the seat occupied by the observer, a long series of settings were made by a person who sat in a chair which rested upon a platform inclined about 5°, first towards the left and then towards the right. The feet of the observer were placed upon the rungs of the chair. The exact agreement of the deviations, as shown in the following table (II) is, of course, accidental, but it is clear that the inclination of the seat did not appreciably affect the judgment of this person.

Table II.

Seat inclined to the left.				Seat inclined to the right.			
Horizontal settings.		Vertical settings.		Horizontal settings.		Vertical settings.	
Left eye.	Right eye.	Left eye.	Right eye.	Left eye.	Right eye.	Left eye.	Right eye.
−0°.3	+0°.7	+0° 5	+0°.7	−0°.3	+0°.7	+0°.5	+0°.7

If, while a person is sittting or standing, the head be much inclined, the deviations of the settings of the cross hair become much greater than when the head is erect. The apparently horizontal and the apparently vertical lines seem always to be turned out of their true position in clockwise direction when the head is inclined to the right, and in counter-clockwise direction when the head is turned to the left.

At the suggestion of Professor C. E. St. John, some settings were made while the observer lay on a horizontal raised board with head supported so that the line joining the eyes was vertical. In this case the deviations were enormous, as may be seen in the results given in Table III. It will be observed that the apparently horizontal and vertical lines were in all cases turned from their true positions, in clockwise direction if the observer was lying on his right side, and in counter-clockwise direction if he was lying on his left side. If, after a setting had been made, the observer looked away from the instrument and at the walls of the room for a little while and then back again into the telescope, the deviation seemed enormous at first, but it decreased rapidly and continuously, and at the end of, perhaps, ten seconds the setting seemed again good. While making these observations the eyes were carefully screened.

The observers were those denoted by the same numbers in Table I.

The second piece of apparatus is represented, though without its screen, in the accompanying figure. The observer, looking through a horizontal tube about 35 centimeters in diameter and 2 meters long, which shuts out of sight extraneous objects and is blackened inside and furnished with several diaphragms to prevent reflection from the inner surface, sees a white circular field 35 centimeters in diameter, divided into halves by a fine, straight, black ink line. This field is the central portion of a large piece of smooth cardboard, mounted on a wooden disc, 75 centimeters in diameter. The disc is in a vertical plane perpendicular to the line of sight, and can be turned about a horizontal axis in the geometrical axis (produced) of the observing tube. By the use of simple mechanism the observer may rotate the disc until the line on the cardboard seems to him horizontal or vertical. Its deviation from true horizontality or verticality can then be read off, to a hundredth of a degree if such accuracy is ever desirable, by an assistant with the help of a microscope and scale on the back of the disc.

While using this apparatus the observer can stand on a platform of proper height, level or inclined, or he may sit on a high chair. In any case his eyes must be properly screened* so that he cannot see any outside objects. The apparatus is furnished with a large metal screen not shown in the illustration.

TABLE III.

Observer.	Mean of horizontal settings made while lying on the				Mean of vertical settings made while lying on the			
	left side,		right side,		left side,		right side,	
	by the left eye.	by therig eye.	bythe ; eye.	by the right eye.	by the left eye.	by the right eye.	by the left eye.	by the right eye.
1	—16°	——-	——	+ 9°	—14°	——	——-	+20°
4	—10	—11°	+10°	+ 6	— 6	—13°	+ 7°	+ 4
5	—11	——-	——	+15	— 7	——	——-	+18
8	—22	—13	+11	+17	—22	—15	+19	+14

* In some experiments made recently in the laboratory of Professor Cattell, of Columbia University, the observer was wisely stationed in a perfectly dark room.

TABLE IV.

Observer.	Horizontal Settings. (The readings show deviations from level.)					Vertical Settings. (The readings show deviations from verticality.)				
	The mean of the set of readings.	The algebraically smallest reading.	The algebraically largest reading.	The "range" of the readings.	The average deviation of the readings from their mean.	The mean of the set of readings.	The algebraically smallest reading.	The algebraically largest reading.	The "range" of the readings.	The average deviation of the readings from their mean.
1	−1°.19	−1°.48	−0°.85	0°.63	0°.21	−1°.02	−1°.39	−0°.55	0°.84	0°.21
2	−0 .16	−1 .00	+0 .62	1 .62	0 .32	−0 .03	−0 .98	+0 .64	1 .62	0 .36
3	−0 .44	−1 .10	+0 .32	1 .42	0 .32	−0 .55	−1 .70	+0 .28	1 .98	0 .33
4	−0 .10	−1 .41	+1 .10	2 .51	0 .48	−1 .59	−3 .10	−0 .50	2 .60	0 .62
5	+0 .26	−0 .53	+1 .07	1 .60	0 .33	+1 .29	+0 .42	+2 .36	1 .94	0 .42
6	−1 .22	+2 .13	−0 .50	1 .63	0 .32	−0 .59	−1 .37	+0 .05	1 .42	0 .29
7	−0 .44	−0 .90	−0 .02	0 .88	0 .25	−0 .46	−1 .56	+0 .42	1 .98	0 .44
8	−0 .81	−1 .50	−0 .30	1 .20	0 .24	−0 .30	−0 .70	+0 .06	0 .76	0 .20
9	−0 .38	−1 .12	+0 .04	1 .16	0 .24	+0 .42	−0 .26	+1 .08	1 .34	0 .32
10	±0 .00	−0 .72	+0 .60	1 .32	0 .26	+0 .08	−0 .70	+0 .95	1 .65	0 .53
11	+0 .56	−0 .45	+1 .40	1 .95	0 .33	−0 .33	−1 .08	+0 .38	1 .46	0 .36
12	−0 .11	−1 .00	+0 .55	1 .55	0 .37	−0 .10	−0 .83	+0 .67	1 .50	0 .25
13	−0 .23	−1 .30	+0 .57	1 .87	0 .39	−0 .10	−1 .07	+0 .83	1 .90	0 .44
14	−0 .01	−0 .64	+0 .57	1 .21	0 .24	+0 .50	−0 .17	+1 .48	1 .65	0 .34
15	+0 .01	−0 .76	+0 .65	1 .41	0 .27	−0 .09	−1 .25	+0 .70	1 .95	0 .38
16	+0 .17	−2 .03	+2 .02	4 .05	0 .01	−1 .41	−2 .89	+1 .62	4 .51	0 .67
17	+0 .42	−0 .11	+0 .92	1 .03	0 .23	+0 .77	−0 .17	+1 .61	1 .78	0 .37
18	+0 .81	+0 .35	+1 .52	1 .17	0 .27	−0 .05	−0 .65	+1 .30	1 .95	0 .50
19	+0 .28	−0 .98	+1 .82	2 .80	0 .69	−0 .32	−1 .78	+0 .77	2 .55	0 .49
20	−0 .16	−0 .80	+0 .80	1 .60	0 .27	+0 .64	+0 .01	+1 .48	1 .47	0 .41
21	+0 .18	−0 .62	+0 .85	1 .47	0 .29	+0 .01	−0 .77	+0 .76	1 .53	0 .26
22	−0 .04	−0 .64	+0 .43	1 .07	0 .17	+0 .02	−0 .30	+0 .44	0 .74	0 .18
23	+0 .19	−0 .60	+0 .86	1 .46	0 .33	+0 .33	−0 .62	+1 .15	1 .77	0 .49
24	+0 .04	−1 .43	+1 .60	3 .03	0 .65	−0 .67	−2 .27	+1 .44	3 .71	0 .67
25	−0 .86	−3 .71	+1 .87	5 .58	1 .39	−0 .81	−4 .01	+4 .05	8 .09	0 .75
26	−0 .45	−2 .52	+1 .81	4 .33	0 .71	−1 .55	−3 .40	−0 .37	3 .03	0 .61
27	+1 .16	+0 .65	+1 .56	0 .91	0 .16	+0 .97	+0 .68	+1 .35	0 .67	0 .13
28	+0 .39	+0 .01	+0 .79	0 .78	0 .20	−0 .07	−0 .52	+0 .35	0 .87	0 .16
29	−0 .38	−1 .60	+0 .50	2 .10	0 .58	−0 .59	−1 .19	+0 .20	1 .39	0 .36

With this apparatus many hundreds of settings were made. Table IV. contains the results of a large number of these made by 29 different persons, each one of whom, while making his long set of observations, stood at ease in front of the tube and, using both eyes, attempted to set the line correctly. All the angles are here given, as they were first read, to hundredths of a degree, but it is evident that the last figure is generally nearly meaningless. Of these 29 persons, two (Nos. 25 and 26) are boys 10 and 8 years old, respectively, and No. 16 is a somewhat older boy. Nos. 23 and 24 are young girls. The ranges of four of these five children are noticeably large. No. 21 is a lady. Thirteen of the other observers, all of whom are men, are either instructors in Harvard University, or other members of the staff of the Jefferson Physical Laboratory. It should be said that a given number may represent different observers in the different tables.

Eleven of the twenty-nine subjects were known to be astigmatic. Most of these could see very imperfectly without eyeglasses, and yet they could set the line about as accurately without these glasses as with them. For instance, the means of horizontal and vertical settings made by observer No. 13 without his spectacles, were − 0°.20 and + 0°.02 respectively. There does not seem to be any obvious connection between the directions of the principal axis of the eyes of an astigmatic observer and the bias shown by his observations.

The average range of the 24 adult persons represented in the Table is 1°.45 for horizontal settings and 1°.56 for vertical settings. The corresponding ranges of so many of these persons as were distinctly astigmatic were 1°.48 and 1°.56 respectively. The average deviation of the horizontal settings of the astigmatic adults is 0°.46 and of the other adults 0°.35. The corresponding average deviations of the vertical settings were 0°.32 and 0°.54. I have partial records for a good many other persons but the numbers given in the Table are fairly representative.

Taking into account all the results, and calling the mean of a great number of readings of settings made by any person, his 'deviation,' we may say, that persons entirely untrained in making measurements, generally set the line rather carelessly, as children do, and have large ranges, though their deviations are not especially large. Trained observers have smaller ranges than other people, but their deviations are not noticeably small. Astigmatism, so severe as to require the constant use of spectacles, does not seem to affect the readings much. Only one person in ten is likely to have a deviation as great as 1° for horizontal settings, while one person in five may be expected to have a deviation of 1° or more for vertical settings. A deviation as great as 1°.6 is very unusual, but many persons may be found whose deviations both from horizontality and verticality are less than 0°.1. The average deviation is about 0°.4 for horizontal settings, and about 0°.5 for vertical settings.

If the platform upon which the observer stands be inclined (sidewise) to the horizon, he becomes ill at ease and his deviations are generally altered. Whether the platform is tipped downward towards the left or towards the right, however, seems in many cases not to affect the signs of the new deviations, which are sometimes, if not usually, mere exaggerations of those obtained when the platform is level. A certain skillful mechanician, for instance, had deviations from horizontality and verticality of + 0°.5 and — 0°.8, respectively, with platform inclined 5° downward to the right, and corresponding deviations of +0°.6 and — 0°.6 with platform inclined to the left. His horizontal and vertical deviations when the platform was level, were positive and negative respectively, but not greater than 0°.1 in either case.

If the observer stood on a level platform, squarely facing in a direction at right angles to the axis of the tube, and then looked over his shoulder, using both eyes and turning only the head and neck, he was still able to set the line horizontal or vertical with some accuracy. The horizontal deviations of two observers while standing in the way just described and looking over their right shoulders were ± 0°.0 and — 1°.0. Their vertical deviations were — 0°.2 and — 1°.0.

Table V. gives the results of some settings taken when the observer, using only one eye, stood at his ease in front of his instrument.

TABLE V.

Observer.	Means of horizontal settings made with			Means of vertical settings made with		
	the right eye.	the left eye.	both eyes	the left eye.	the right eye.	both eyes.
1	—0°.4	—0°.1	±0°.0	±0°.0	—0°.1	±0°.0
2	+1 .4	—0 .7	+1 .4	+1 .3	+0 .2	+0 .8
3	+0 .1	+0 .8	±0 .0	—0 .4	±0 .0	+0 .1

It should be said that the first two of th ese observers when asked to point quickly at a distant object, always indicate a line passing midway between the eyes, and not a line passing through one eye, as many people do.

Two persons successively took observations by standing on a shelf with back squarely turned to the tube and trying to set the line horizontal while looking backwards between the legs with head inverted.

The deviation of one of these persons was $-1°.4$. The settings of the other were always positive when made from the positive side and negative when made from the negative side. The average deviation of a single setting made by this person was in absolute amount $1°.5$.

When settings are made by a person while standing squarely before the instrument with his head *much* inclined to one side, the deviations are always clockwise when the inclination is to the right, and counter-clockwise when the inclination is to the left. When the inclination is small it is, of course, not possible to predict the signs of the deviations. The settings of one observer, and of only one among several who were examined, were exceptions to the rule when the head was inclined as much as 20°. In Table VI. the first line gives the deviations of an observer fairly representative of the average, and the second line those of the exceptional person just mentioned. The inclinations were very nearly 20° in all cases.

TABLE VI.

Observer.	Horizontal settings made, when the head was inclined to the						Vertical settings made when the head was inclined to the					
	Left,			Right,			Left,			Right,		
	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.	using the left eye.	using the right eye.	using both eyes.
1	$-2°.3$	$-0°.9$	$-2°.0$	$+2°.1$	$+1°.4$	$+1°.9$	$-1°.9$	$-2°.2$	$-1°.9$	$+0°.7$	$+1°.5$	$+1°.4$
2	$+1\ .3$	$+3\ .4$	$+2\ .1$	$-0\ .6$	$+0\ .9$	$+1\ .4$	$+1\ .1$	$+2\ .2$	$+1\ .2$	$-0\ .6$	$-1\ .0$	$-2\ .4$

When the observer lay on one side on a horizontal shelf, with the line joining his eyes vertical, and with head well screened for some time before he made his settings, the deviations were in all cases clockwise if he lay on his right side and counter-clockwise if he lay on his left side, whether he used one eye or both. The magnitudes of the deviations, though very different with different people, were often as great as 20°.

B. O. Peirce.

The Jefferson Physical Laboratory,
Harvard University.

THE DEVONIAN SYSTEM IN CANADA.

II.

2. ONTARIO AND KEEWATIN (HUDSON BAY).

While Logan was exploring the Gaspé sandstones in 1843, Mr. A. Murray, then Assistant Geologist to the Canadian Survey, was engaged in a "geological examination of the district lying in a general line between Georgian Bay, on Lake Huron, and the lower extremity of Lake Erie." In his report on that year's operations, published in 1845, Mr. Murray correctly, and for the first time, regards the rocks at Port Colborne, Cayuga, etc., which he calls the Upper Limestones, as the equivalents of the Corniferous limestone of the State of New York. The black bituminous shales at Kettle Point, Lake Huron and on the Sydenham River, that he examined in 1848, he at first thought to be part of the Hamilton formation, but in 1855 he re-examined these shales and some of the exposures on the Sable River and in the township of Bosanquet, in company with James Hall, upon whose authority the former were decided to represent the lowest member of the Portage and Chemung group and the latter the Hamilton formation. But this statement was not published until 1857.

The discovery of the Oriskany sandstone at Cayuga would seem to have been made, or rather first recorded, by E. Billings, in May, 1860. For, in the preface to his now classical paper 'On the Devonian Fossils of Canada West,' Mr. Billings says that the "Devonian rocks of Canada West consist of portions of the Oriskany sandstone,

Schoharie grit, Onondaga limestone, Corniferous limestone, Hamilton, Portage and Chemung groups.'' This paper was originally published in four parts, and in the third and fourth parts, fourteen of the species of brachiopoda therein enumerated or described are said to occur in the Oriskany. The 'Geology of Canada,' published in 1863, contains a list of thirty species of fossils from the Ontario Oriskany, most of which, in the Museum of the Geological Survey at Ottawa, are labelled as having been collected by J. De Cew. In that publication it is stated that only the lowest of the three divisions of this formation extends into Ontario; that it occupies only a few small areas in the townships of Dunn, Oneida and Cayuga, as a 'very narrow border' to the Corniferous, and that it 'seldom exceeds about six feet in thickness.' A 'list of the fossils occurring in the Oriskany sandstone of Maryland, New York and Ontario,' by Mr. Charles Schuchert, published in 1889, in the 'Eighth Annual Report of the Geologist of the State of New York,' contains the names of seventy-six species from Cayuga. Most of the Ontario material from which this list was made was probably obtained from Mr. De Cew. But Mr. Schuchert, who made additional collections of the fossils of the Ontario Oriskany for the United States National Museum in 1895, says, in a recent letter to the writer, that he then saw how easy it is to mix Oriskany and Corniferous fossils while collecting, and believes that the collections made by Mr. De Cew are mixed. Mr. Schuchert thinks that near Cayuga there is a transition zone between the Oriskany and the true Corniferous, and that many of the fossils recorded in the 'Geology of Canada' as from the Oriskany may be from this zone. Further, he is of the opinion that it is only the uppermost portion of the Oriskany that is represented near Cayuga.

The fossils of the Corniferous formation or Upper Helderberg group of Ontario have been determined or described, either separately or together with those of the Hamilton formation, by E. Billings and Professor H. A. Nicholson, in Canadian publications ranging from 1857 to 1895. Incidentally they have been described or enumerated by James Hall in the thirty-fifth regents' report of the New York State Cabinet of Natural History, and in volumes four to eight of the Paleontology of that State, also by Dr. Carl Rominger in his 'Fossil Corals' of Michigan.

Tabulating the information obtainable from these and other sources, and omitting names that have long been known to be synonyms, the number of species of fossils that have been recorded from this formation in Ontario would seem to be 258, as follows:

Corals (inclusive of Stromatoporoids)	100
Vermes	1
Polyzoa (= Bryozoa)	40
Brachiopoda	60
Pelecypoda (=Lamellibranchiata)	10
Gasteropoda	17
Cephalopoda	8
Ostracoda	1
Trilobita	17
Fishes	4
	258

In addition to these, there are in the Museum of the Canadian Survey, a few fragmentary crinoids, several species of polyzoa, a few brachiopoda, pelecypoda and gasteropoda, and one pteropod (an undetermined species of *Tentaculites*) from the Corniferous of Ontario, that have yet to be studied.

From this list it would appear that corals form by far the most conspicuous feature in the fauna of the Ontario Corniferous. But, although in places this formation is mainly a large coral reef, it is obvious that quite a number of the species that have been proposed therefrom are based upon very insufficient characters. For some time past the writer's friend and colleague, Mr. L. M.

Lambe, has been engaged in a much-needed revision of the Canadian paleozoic corals, and when this revision is completed, as it is hoped it soon will be, it will doubtless materially reduce the number of species from the Corniferous of the province. On the other hand, the number of species of polyzoa, brachiopoda and mollusca from that formation, in collections that have yet to be studied, will be quite largely increased.

The fossils of the Hamilton formation of Ontario have been reported on by Billings, Nicholson, Hall, and more recently by the writer, who has published two small monographs upon them. In the latter of these, published in November, 1898, 219 species are recognized and recorded, as follows:

Sponges	2
Corals (inclusive of Stromatoporoids)	40
Echinodermata	16
Vermes	14
Polyzoa (= Bryozoa)	40
Brachiopoda	61
Pelecypoda (= Lamellibranchiata)	13
Gasteropoda	12
Pteropoda	3
Cephalopoda	8
Ostracoda	3
Phyllopoda	1
Trilobita	4
Fishes	2
	219

Several additional species of Fenestellidæ and Monticuliporidæ are indicated in the Canadian Survey and other collections by mere fragments that have not yet been critically examined. From a comparison between the foregoing lists it would appear that echinodermata and vermes are more numerous in genera and species in the Hamilton formation than in the Corniferous, but eight of the fourteen specimens of vermes from the Hamilton formation are jaws or teeth of conodonts that are very small and difficult to find.

The black shales at Kettle Point, which are supposed to represent the Genesee slates of the State of New York, have so far yielded only a still undetermined *Lingula*, and four species of fossil plants (*Calamites inornatus*, *Lepidodendrum primævum*, macrospores of *Protosalvinia Huronense*, and a *Spirophyton*) that have been determined or described by Sir William Dawson.

The Tully limestone, the supposed representative of the Cuboides zone of the European Devonian, and the Naples beds, or Intumescens zone, of western New York, have not yet been recognized in Ontario.

One of the results of the explorations of Dr. R. Bell in 1871, 1875, 1877 and 1886, on behalf of the Geological Survey of Canada, was the discovery of a large area of Devonian rocks to the west and southwest of James Bay. In 1871 Dr. Bell collected a few fossils on the Albany River (which is now part of the dividing line between Ontario and the District of Keewatin) between Marten's Falls and the Forks; and in 1886 a much larger number on the same river below the Forks. Some of these fossils are from a yellowish gray limestone, and those obtained from this limestone in 1886 represent seventeen species. Twelve of these appear to be identical with Corniferous species from Ontario and New York State, and the remainder are either undeterminable or undescribed. Others are from small patches of red marl, and these fossils seem to indicate the Hamilton formation, the prevalent species being perfect and well preserved specimens of *Spirifera pennata* (Atwater), formerly known as *S. mucronata*, Conrad.

Collections of fossils that are obviously of Devonian age were made by Dr. Bell in 1875 and 1877 on the Moose River and two of its larger tributaries, the Missinaibi and Mattagami. Lists of these fossils, most of which are identical with well-known Corniferous species, were published in the 'Reports of Progress of the Geological Survey of Canada' for 1875–76 and 1877–78. For many years a number of fossils from

the Devonian rocks of the Albany River at Old Fort Henley and of the Moose River, collected by the late Mr. George Barnston about 1834 or 1835, have been in the Museum of the Canadian Survey, but nothing appears to have been published about them.

In Keewatin a few fossils that are probably of Devonian age were collected in 1886 by Dr. R. Bell at two localities on the Attawapishkat River, and by Mr. Low from the Limestone Rapids on the Fawn branch of the Severn River. These fossils have not yet been critically studied, but among those from the last-mentioned locality there is a recognizable fragment of *Sphærospongia tesselata*, which is one of the most characteristic species of the Stringocephalus zone of the Manitoba Devonian. The existence of Devonian rocks on Southampton Island has been quite recently inferred from the fact that a few fossils from that island lent to Dr. Bell by a missionary in 1898 are similar to those from the Attawapishkat River. Dr. Bell had previously stated that the limestone on Southampton Island is "evidently exactly the same as that of Mansfield Island."* If this be the case the limestone of Mansfield Island may possibly be Devonian, rather than Cambro-Silurian as previously supposed.

3. MANITOBA AND THE NORTH-WEST TERRITORIES.

The Devonian age of the limestones on Snake Island, Lake Winnipegosis, and Manitoba Island, in the lake of that name, was asserted by E. Billings in 1859, on the evidence of a few fossils collected therefrom in 1858. At that time Mr. Billings was under the impression that these limestones are, as he says, 'most probably about the age of the Hamilton group.'† In 1874 Dr. J. W. Spencer collected some fossils, which Mr. Billings pronounced to be also of Devonian age, from rocks on the islands and shore of Swan Lake and on the western shore of Dawson Bay, Lake Winnipegosis. Still more recently an almost exhaustive geological examination of the islands, shores and immediate vicinity of lakes Manitoba and Winnipegosis was made by Mr. J. B. Tyrrell in 1888 and 1889. Assisted by Mr. D. B. Dowling, Mr. Tyrrell also made an exceptionally large collection of the fossils of the Devonian rocks of this region. This collection, which has been reported on somewhat fully by the writer in two illustrated papers published in 1891,* and 1892,† was found to consist of 133 species, but about nineteen of these could not then be determined specifically. Two additional species of corals in this collection have since been determined, and an additional species of pteropoda from a collection made later has been described, making the total of identified or described species now known from these rocks to be 117, as follows:

Sponges (inclusive of Receptaculitidæ)	2
Corals (inclusive of Stromatoporoids)	17
Vermes	1
Polyzoa (= Bryozoa)	5
Brachiopoda	18
Pelecypoda	25
Gasteropoda	29
Pteropoda	2
Cephalopoda	9
Ostracoda	3
Trilobita	3
Fishes	3
	117

According to Mr. Tyrrell these fossils are exclusively from the Middle and Upper Devonian of the province, for the Lower Devonian has not yet been satisfactorily recognized in Manitoba, though it may be

* Geological and Natural History Survey of Canada, Report of Progress for 1882–83–84, p. 34 D.D.

† Hind's report on the Assiniboine and Saskatchewan Exploring Expedition, Toronto, p. 187.

* Transactions of the Royal Society of Canada, Vol. VIII., Sec. 4, p. 93.

† Geological Survey of Canada, Contributions to Canadian Paleontology, Vol. I., pt. 4.

represented by about 100 feet of red and other shales, from which no fossils have yet been collected. In any case they are of special interest as showing certain well marked and not altogether unexpected points of resemblance to those of the English and European Devonian. For, the upper half of the Manitoba Middle Devonian, or Winnipegosan formation of Mr. Tyrrell, consists of a tough white dolomitic limestone holding numerous examples of a large *Stringocephalus* which is apparently identica with the *S. Burtini* of Defrance and other European authors. Moreover, it is here associated with many fine specimens of *Sphærospongia tesselata*, Phillips, and with fossils that cannot at present be distinguished from the following well-known European species:

Cladopora cervicornis (De Blainville).
Spirorbis omphalodes, Goldfuss.
Productella productoides (Murchison).
Stropheodonta interstrialis (Phillips).
Atrypa reticularis, L.
Atrypa aspera, Schlotheim.
Pugnax pugnus (Martin).
Paracyclas antiqua (Goldfuss).
Murchisonia turbinata, Schlotheim.
Euomphalus annulatus, Phillips.
Loxonema priscum, Munster.
Macrochilina subcostata (Schlotheim).

The Stringocephalus limestone of Manitoba would seem to occupy much the same stratigraphical position as that of Devonshire, Rhenish Prussia and Belgium, and its fossils show that it is probably their homotaxial equivalent.

Immediately above the Stringocephalus zone in Manitoba there are beds which may possibly represent the Cuboides zone, although *Rhynchonella*, or, as it is now called, *Hypothyris cuboides*, has not yet been found in them. The prevalent fossils in these beds are *Cyathophyllum dianthus* and *C. vermiculare*, var. *præcursor* (teste Frech); *Chonetes Logani* var. *Aurora*, *Productella subaculeata*, *Orthis striatula*, *Stropheodonta arcuata*, and *Cyrtina Hamiltonensis*, which the Rev. G. F. Whidborne has recently asserted is the same as the European *C. heteroclita*.

Regarding the fossils of the Manitoba Devonian as a whole, it is to be noted that it is not the corals, nor the polyzoa (or bryozoa), nor the brachiopoda that have as yet yielded the largest number of species (as they have in Ontario), but the gasteropoda and pelecypoda.

From the northern end of Lake Winnipegosis the Devonian rocks extend into the immediately adjacent district of Saskatchewan.

It has long been known that the eastern ranges of the Rocky Mountains in Alberta are mainly composed of Carboniferous or Devonian, or perhaps of Carboniferous *and* Devonian, limestones and shales. These rocks were examined in 1858 and 1859 by Sir James Hector, who writes as follows in regard to them:

"These limestones are of dark and light blue colour, crystalline, compact or cherty, with fossils that are either of Carboniferous or Devonian age, the principal of which are *Spirifer*, *Orthis*, *Chonetes*, *Conularia*, *Lonsdalia*, *Cyathophyllum*, *Lithostrotion*, etc." * * * "Along with them are softer beds of gritty, sandy shale, generally of a dull red or purple colour." * * * "In the second range we have the same limestones and shales repeated as in the first, but at the base I observed traces of a magnesian limestone of a buff colour, containing *Atrypa reticularis*, a true Devonian fossil."† * * * "On the Kicking Horse River, in the third range, we have the mountains again formed of blue limestone, along with a compact blue schist with red bands, giving a curious striped aspect to the rocks."‡

In reference to these remarks, Dr. G. M. Dawson, who made a geological examination of the South Kootanie Pass and its vicinity, in 1874, adds the following comments:

"Dr. Hector is not very clear as to the separation of the supposed Devonian and Carboniferous limestones, and they may indeed very probably belong to

* Palliser's Explorations in British North America, 1863, p. 239.

† Quarterly Journal of the Geological Society of London, Vol. XVII., 1861, p. 443.

‡ Palliser's Explorations in British North America, p. 239.

a single series. Professor Meek, in describing fossils from limestones occurring in the mountains south of the boundary line, which, from the general facies, he believed to be Carboniferous, mentions the fact that the forms, without exception, belong to genera which are common both to that formation and the Devonian, and of which a small number are represented in the Silurian." *

In 1881, 1883 and 1884 Dr. Dawson was engaged in an examination of the geological structure of parts of the Rocky Mountains in Alberta between Lat. 49° and Lat. 51° 30′, the results of which were published in the 'Annual Report of the Geological Survey of Canada' for 1885 (Vol. I., New Series). This report contains preliminary lists of a few supposed Devonian fossils, from the limestones on the summit of the North Kootanie Pass, on Crow Nest Lake, and from the lowest beds exposed at the west end of the cañon on the Cañon branch of the Elbow River.

Subsequently Mr. R. G. McConnell made a geological survey of the Rocky Mountains between the Canadian Pacific Railway and the North Saskatchewan in 1885, and a more detailed exploration than had yet been made, of the geology of those in the more immediate neighborhood of that railway, in 1886. He published in the 'Annual Report of the Geological Survey of Canada' for 1886 a geological section across the Rocky Mountains in the vicinity of the Canadian Pacific Railway, with a diagram showing the formations represented in the sections to the west of the Castle Mountain Range, and another of those represented in sections to the east of that range. In the latter only four geological systems or formations are recognized, namely, the Cambrian, which Mr. McConnell calls also the 'Castle Mountain Group'; the Devonian, which he designates also as the 'Intermediate Limestone'; the Devono-Carboniferous, which he calls the 'Banff Limestone'; and the Cretaceous. In the text it is stated that the Intermediate Limestone is "mainly composed of a great series of brownish dolomitic limestones and has a thickness of about 1500 feet." Its fossils are "usually badly preserved and consist mainly of almost structureless corals." The few that were collected, it may be added, have not yet been determined and indeed are scarcely determinable. According to Mr. McConnell, the Banff Limestone is the "principal constituent of all the longitudinal ranges east of Castle Mountain." It "has a total thickness of about 5,100 feet and is divisible into a lower and upper limestone and into lower and upper shales." Its fossils are better preserved than those of the Intermediate Limestone, and fairly large and representative collections of the former were made.

These collections have not yet been at all exhaustively studied, but most of the species represented in them are apparently of Carboniferous age. Among those collected in 1886 are two or three small species of *Productus;* a large *Syringothyris;* a *Pugnax* closely allied to if not identical with *P. Rockymontana*, Marcou; a *Hustedia* like *H. Mormoni* (Marcou); and two well-marked pygidia of *Prætus peroccidens*, Hall and Whitfield. The specimens from the black fissile shales of the Bow River, collected by Mr. McConnell in 1885, that were provisionally referred to the Devonian genus *Clymenia* on page 18 D of his report, do not show clear indications of either septa or siphuncle, and may, therefore, be casts of a discoidal gasteropod. On the other hand, in 1885 Mr. McConnell obtained a few specimens, that are unquestionably referable to *Atrypa reticularis*, from the Rocky Mountains at the Pipestone Pass Falls, and from the first range on the North Saskatchewan. It was from the mountains at the source of the North Saskatchewan that

* 'Report on the Geology and Resources of the Region in the Vicinity of the Forty-ninth Parallel,' etc., 1875, p. 71.

the specimens were collected by Sir James Hector which Salter referred to *A. reticularis.*

In 1898 Mr. J. McEvoy collected a few fossils at several localities in the first foothill of the Rocky Mountains, in Alberta, where it intersects the valley of the Athabasca. These fossils have not yet been very critically examined, but those from two of these localities are probably Carboniferous, and the remainder either Carboniferous or Devonian.

In 1868 Mr. F. B. Meek published a paper entitled 'Remarks on the Geology of the Valley of the Mackenzie River, with figures and descriptions of Fossils from that region, in the Museum of the Smithsonian Institution, chiefly collected by the late Robert Kennicott, Esq.,' in the first volume of the Transactions of the Chicago Academy of Sciences. The paper consists of a concise history of the discovery of Devonian rocks at various localities in the Athabasca, Mackenzie River and Yukon districts by Sir John Franklin, Sir John Richardson, Mr. A. K. Isbister, Major R. Kennicott, Mr. R. W. McFarlane, Mr. B. R. Ross and the Rev. W. W. Kirby, followed by descriptions or identifications of thirty-two species of Devonian fossils. Of these species ten are corals, twenty-one are brachiopoda and the remaining one is a cephalopod. Mr. Meek expresses the opinion that the Devonian rocks exposed on the Clearwater, Athabasca, Slave, and Mackenzie Rivers, and on Great Slave Lake, are probably referable to the Hamilton formation.

Since 1868 Devonian rocks have been discovered or examined by officers of the Geological Survey of Canada, and their fossils collected at the following localities in this region. In the Athabasca district, at four different exposures on the Athabasca River and at one each of its tributaries, the Clearwater, Red and Pembina Rivers, by Professor Macoun in 1875, by A. S. Cochrane in 1881, by Dr. R. Bell in 1882 and by R. G. McConnell in 1890; also at three different exposures on the Peace River by Professor Macoun in 1875 and by Mr. McConnell in 1879. In the Mackenzie District, on the banks of the Long Reach of the Lower Liard River and on the Hay River forty miles above its mouth by Mr. McConnell in 1887, and at four different and rather widely distant exposures on the Mackenzie River by Mr. McConnell in 1888.

Most of the fossils from these localities that were collected before 1875 have been provisionally reported on in the Reports of Progress of the Canadian Survey for the years in which they were made. Those, however, that were collected between the years 1875 and 1890, both inclusive, form the subject of an illustrated paper, by the writer, on 'The Fossils of the Devonian Rocks of the Mackenzie River Basin,' published in 1891.* This publication, which is practically a continuation of Mr. Meek's paper on the same subject, already referred to, adds fifty-seven additional species of purely marine invertebrata to the previously known fauna of these rocks, as under:

Sponges	1
Corals (inclusive of Stromatoporoids)	10
Crinoidea	1
Vermes	3
Polyzoa (= Bryozoa)	7
Brachiopoda	20
Pelecypoda	7
Gasteropoda	3
Pteropoda	1
Ostracoda	3
Trilobita	1
Total	57

According to Mr. McConnell, a section of the Devonian rocks in the Mackenzie district, in descending order, would be somewhat as follows:

1. Upper limestone .....(about) 300 feet
2. Greenish and bluish shales alternating with limestone(about) 500 feet

* Geological Survey of Canada, Contributions to Canadian Paleontology, Vol. I., part 3.

3. Grayish limestone, interstratified with dolomites, the lower part of which may be older than the Devonian.....	2,000 feet (or more)

The whole of the fossils collected by Mr. McConnell, Professor Macoun and Dr. Bell are from the upper part of the middle division of this section. Of the fifty-seven species of fossils in the foregoing list, twenty-two are apparently found also in the Hamilton formation of Ontario and the State of New York; ten (but only six additional ones) in the Devonian rocks of Iowa now referred to the Chemung; and seven in the Chemung of the States of New York and Pennsylvania. On the other hand, there are strong reasons for supposing that the whole of these fossils are from a horizon nearly corresponding to that of the 'Cuboides zone' of Europe. In the first place, three specimens of a brachiopod which the writer has identified with the *Rhynchonella* (now called *Hypothyris*), *cuboides* of Sowerby, were collected by Mr. McConnell, one at the Hay River in 1887, and two on the Peace River at Vermilion Falls in 1889. It is true that Mr. Schuchert thinks that these three specimens should be called *Hypothyris Emmonsi*, but Mr. Walcott had previously expressed the opinion (in 1884) that "there is little doubt but that *Rhynchonella intermedia*, *R. Emmonsi* and *R. venustula*, Hall, are varieties of *R. cuboides*,* of the Devonian of Europe." On the Hay and Peace Rivers the supposed *Hypothyris cuboides* is associated with *Spirifera disjuncta* (or *Verneuili*), and other fossils that are elsewhere supposed to be characteristic of the Cuboides zone are to be met with in the published lists of species from the Athabasca and its tributaries, or the Mackenzie. The discovery by Mr. McConnell, at the Ramparts on the Mackenzie River, of two large specimens of a *Stringocephalus* which cannot at present be distinguished from *S. Burtini* may indicate a northwestward extension of the Stringocephalus limestone of Manitoba. The still later recognition by Dr. John M. Clarke, in 1898, of *Manticoceras intumescens* in the cast of the interior of three chambers of the septate portion of a species of Goniatite from the Hay River, collected by Mr. McConnell and figured by the writer, would seem to indicate the existence of the equivalent of the 'Intumescens zone,' or Naples fauna at that locality.

* Monographs of the United States Geological Survey, Vol. VIII. (Paleontology of the Eureka District), page 157.

The present state of our knowledge of the Devonian rocks of the whole Dominion, from a purely paleontological standpoint, may be thus briefly summarized. We now possess a fairly satisfactory knowledge of the fossils of the Devonian rocks of Ontario, and of the relations which these rocks bear to the typical section in the State of New York. The fossil plants of the Gaspé sandstones have been described and figured by Sir William Dawson, and the remarkable assemblages of fossil fishes from the Upper Devonian of Scaumenac Bay and Lower Devonian near Campbellton have been worked out somewhat exhaustively, the earlier collections in Canada, and the later ones by the best ichthyological authorities in London and Edinburgh. We have now some idea of the fossil fauna of the Manitoba Devonian, and have added materially to our knowledge of the fossils of the Devonian rocks of the Athabasca and Mackenzie River districts. But, on the other hand, our knowledge of the organic remains of the Devonian of Nova Scotia is still in its infancy, and it would seem that the plant-bearing beds near St. John's, N. B., which have so long been regarded as Devonian, may possibly be Carboniferous. In the Rocky Mountain region of Alberta we have not always succeeded in distinguishing Devonian rocks

from Carboniferous, and we have yet to obtain a much fuller knowledge than we now possess of the Devonian fossils of Keewatin and the area to the southwest of James Bay.

J. F. Whiteaves.

Ottawa, June 28, 1899.

SECTION B—PHYSICS.

The work of this section at the Columbus meeting was extremely gratifying to those who were fortunate enough to attend; although no papers of an epoch making nature were presented, still all those which were read were of a good character, and seemed to represent a large part of the work in physics in this country, for the past year or more. Several of the papers were of considerable importance, and it is hoped that they will find their way into the columns of this Journal before long.

The meetings of the section were well attended and the discussions were intelligent, interesting and to the point. It should be a matter of congratulation that the Association succeeded in collecting at Columbus so large a number of working physicists and presented such a good series of papers. It seems that more and more such scientists and such papers as are found at the meetings of the British Association are coming to these meetings.

The address of the Vice-President, Dr. Elihu Thomson, 'On the Field of Experimental Research,' was published in Science for August 25th.

Professor Caldwell presented a number of interesting diagrams, which by appropriate super-position enable one to point out the constants of current and electromotive force in the rotary converter. These diagrams must be extremely useful in presenting the complex question of the operation of these machines.

Professor Eddy showed a simple and convenient method for constructing the entropy-temperature diagrams of a gas or oil engine from the indicator card; and showed how these diagrams enable one to readily detect the advantages or defects in the running of such engines.

Mr. Briggs' new variable condenser consists of a series of alternating plates of mica and spring brass. The capacity is increased by compressing the plates together by means of a thumb-screw.

In photometric operations we are accustomed to compare the relative illumination of two surfaces by looking at them, and guessing at their relative intensity, or by endeavoring to make the illumination of the two surfaces equal. In Professor Cattell's method, however, the difference between the two surfaces is measured by the time it requires for the observer to decide which of the two surfaces is the brighter; it being a fair assumption that the difference in the impressions is a function of the time required to distinguish between them. A considerable series of observations have confirmed the belief that this method is not only applicable but highly advantageous.

In Professor Cattell's other paper, he brought before the section an extremely interesting and novel observation, which must throw considerable light upon the relative importance of the retina and the brain in the operation of vision. He finds that if, by a motion of the eye, the images of black and white bars are made to pass over the retina at the rate of even a hundred or a thousand per second, still the eye or the brain perceives them as individual bars, and not as a fused gray surface; of course, when the eye is stationary, if light and dark images are caused to pass over the retina at a much less rate, we have perfect fusion. Thus it seems a matter of vital importance in distinct vision, when the image moves on the retina, whether the eye is moving and the object stationary, or the reverse. These experiments indicate that the phenomena of vision are chiefly cerebral

and not chiefly retinal, and that our operation of vision has been developed by evolution to that which is necessary for convenience and self-preservation.

The two papers by Mr. Wead were of special interest from the historical point of view, presenting on the one hand, with considerable elaboration, the development of the organ pipe as seen in the various instructions as to their manufacture, length and other dimensions; incidentally the perfection of the organ pipe at any particular era, of course, enables us to judge to some extent as to the musical conditions existing at that time. In the study of the literature of the musical scale, much interesting information has been obtained with reference to the so-called Arab scale, extant descriptions of certain Arab musical instruments, such as the lute, the tambour of Bagdad and others, enable us to see the way in which the musical scale was built up, and how, in many cases, the interpolation of a note in the scale was determined, not by conditions of harmony, but by the dimensions of the neck and the location of frets upon the instrument in use.

A thoroughly new phenomenon in connection with the effect of an alternating current of electricity upon the human system was presented by Dr. Scripture. He has found that when the alternations in a current of electricity become as frequent as 5,000 per second, the nerves of the part affected cease to react to pain, that is, a high frequency alternating current, instead of producing the muscular contraction brought about by lower frequency, produces a local anesthesia or rather analgesia; the current should be sinusoidal with equal positive and negative phases. Experiments have been tried in sending the current along the superior maxillary nerve with a view of cutting off the teeth from connection with the brain; as yet, however, the frequency has not been high enough to obviate contraction of the facial muscles. It would appear that in this phenomenon we have a very valuable contribution to the methods of surgery.

Messrs. Carhart and Guthe have continued their absolute determination of electrical units, and now offer the valve 1.4333 volts at 15° C. as the electromotive force of the standard Clark Cell.

In Mr. Trowbridge's paper on the coherer, we have a praiseworthy endeavor to present quantitative results, instead of haphazard observations upon this instrument which has recently become so important. Using a coherer consisting of 22 hard steel balls in a glass tube, he was able to discover the conditions of current and pressure necessary for the operation of a coherer; he found, for example, that a minimum electromotor force of from 8 to 10 volts is necessary to break down the resistance of the coherer, but that after the resistance had been broken, subsequent discharges do not reduce the resistance much further; it thus would appear that it is the first rush of the electricity through the coherer which produces the result, and that subsequent discharges are without useful effect; that is, an oscillatory discharge is not necessary, a single impulse is sufficient. This observation explains much of the confusion that has puzzled workers in wireless telegraphy.

In No. 12 and No. 16 were presented observations and conclusions with reference to the complex operations that take place in an electrolytic cell. The relations between polarization, capacity and resistance being an extremely puzzling question.

In No. 13 was presented the fact that a magnetic field surrounding an alternating current arc tends to flatten the top of the electric wave and to increase the efficiency. A similar effect is produced by an aluminum electrolytic cell where the formation of a film of oxide acts like the dielectric of a condenser, and reverses the phrase.

In No. 15 the difficulty of determining permeability and hysteresis is pointed out, and it is shown that the pull in the permeater should be represented by

$S(B^2 - B\cdot H)/8\pi$ instead of $S(B^2 - H^2)/8\pi$.

Mr. Wolff told the section of the present condition of the office of standard weights and measures at Washington, and the progress that has been made toward the equipment of the laboratory for the verification of electrical apparatus. It is gratifying to know that even now we have a trustworthy bureau to which electrical standards may be sent for testing.

He also presented some experiments as to whether current density affects resistance, that is as to the universal truth of Ohm's law. If the resistance is expressed as a function of current density in the following form:

$R_c = R_o\left\{1 + h\left(\frac{c}{s}\right)^2\right\}$, $\frac{c}{s}$ is current density, then h cannot be greater than 1/600,000,000.

In No. 20 were presented some extremely interesting and important generalizations with reference to the effect of broad areas of atmospheric pressure upon the weather. This paper will appear in *The American Journal of Science*.

Mr. Brace in No. 21 and No. 22 presented some interesting optical matter whose appearance in detail in the journals will be awaited with interest.

Certainly one of the most important papers presented was No. 23, in which Mr. Fessenden presented a large mass of theoretical and experimental material tending to give a clue as to the nature of electricity and magnetism, and also to give a value for the elasticity and density of the ether. He pointed out the great advantage of discussing physical problems by means of dimensional formulæ, showing that these were particularly valuable in pointing out the direction in which the investigation should tend, and in checking the results of more elaborate mathematical analysis. A detailed abstract of this paper is not embodied here, because it is believed that it will appear in Science before long.

Everyone is now interested in the question of smokeless powder, and the freedom from observation which it gives to the soldier. It is interesting to see in this connection from No. 25, that Mr. Fessenden has discovered a very simple and apparently effective means of locating the flash from smokeless powder, by simply providing the observer with a piece of pale red glass, it having been found that these flashes are strong in red light, whereas the general landscape is very weak in red.

In No. 28 Mr. Fessenden raised the question as to whether it is necessary to suppose that the conditions of terrestrial radiation have always been similar to those which exist at present; in other words, as to whether Lord Kelvin's estimate for the age of the earth which has been declared entirely inadequate by biologists, may not have to be extended, owing to an earlier excessive rate of radiation, due to the absence of a blanketing atmosphere.

No. 29 and No. 30 are valuable contributions to the subject of the wave-length of energy radiated from 'black' bodies at various temperatures.

In No. 32 Mr. Cook has made some interesting computations as to the conditions of time and temperature necessary for a planet to lose an atmosphere consisting of gases, ranging in density from carbonic acid gas to hydrogen.

No. 36 gives a continuation of Mr. Gray's interesting investigation upon the dielectric strength of oils. He finds, for example, that the strength per cm. decreases as the layer increases in thickness.

In No. 37 he has called attention to an error in a new Watt-meter, caused by the

resistance coils absorbing moisture from the atmosphere, and also to the effects of capacity around the fine wire coil of a Watt-meter.

The full program was as follows:

1. Apparatus for the demonstration of the varying currents in the different conductors of a rotary converter. F. C. Caldwell, Columbus, O.

2. A new graphical method of constructing the entropy-temperature diagram from the indicator card of a gas or oil engine. H. T. Eddy, Minneapolis, Minn. Trans. Am. Soc. Mech. Eng.

3. Compound harmonic vibration of a string. W. Hallock, New York, N. Y. SCIENCE.

4. A new form of electrical condenser, having a capacity capable of continuous adjustment. Lyman J. Briggs, Washington, D. C.

5. Relations of time and space in vision. J. McK. Cattell, New York, N. Y. *Psychological Review.*

6. Time of perception as a measure of the intensity of light. J. McK. Cattell, New York, N. Y. *Psychological Review.*

7. The musical scales of the Arabs. Charles K. Wead, Washington, D. C.

8. Medieval organ pipes and their bearing on the history of the scale. Charles K. Wead, Washington, D. C. '*Music*,' Chicago.

9. Electrical anesthesia. E. W. Scripture, New Haven, Conn.

10. An absolute determination of the E.M.F. of a Clark cell. H. S. Carhart and K. E. Guthe, Ann Arbor, Mich. *Physical Review.*

11. Quantitative investigation of the coherer. Augustus Trowbridge, New Haven, Conn. *Am. Jour. Sci.*, Sept., 1899.

12. Polarization and polarization capacity of an electrolytic cell. K. E. Guthe and M. D. Atkins, Ann Arbor, Mich. *Physical Review.*

13. Current and voltage curves in the magnetically blown arc and in the aluminum electrolytic cell. Reginald A. Fessenden, Allegheny, Pa.

14. Some new apparatus — tachometer, chronograph, data collector, induction coil, balance for standardizing amperemeters, standard of induction. Reginald A. Fessenden, Allegheny, Pa.

15. Measurement of magnetism in iron and the relation between permeability and hysteresis. Reginald A. Fessenden, Allegheny, Pa.

16. Polarization and internal resistance of the copper voltameter. B. E. Moore, Lincoln, Nebr. *Physical Review.*

17. Concerning the fall of potential at the anode in a Geissler tube. C. A. Skinner, Lincoln, Nebr. *Wiedemann Annalen.*

18. The equipment and facilities of the Office of U. S. Standard Weights and Measures for the verification of electrical standard and measuring apparatus. F. A. Wolff, Jr., Washington, D. C.

19. An experimental test of the accuracy of Ohm's law. F. A. Wolff, Jr., Washington, D. C.

20. March weather in the United States. O. L. Fassig, Baltimore, Md. *Am. Jour. Sci.*

21. A new spectrophotometer and a method of optically calibrating the slit. D. B. Brace, Lincoln, Nebr.

22. On achromatic polarization in crystalline combinations. D. B. Brace, Lincoln, Nebr.

23. On the nature of electricity and magnetism and a determination of the density and elasticity of the ether. Reginald A. Fessenden, Allegheny, Pa. SCIENCE. Read in joint session with Section A.

24. Advances in theoretical meteorology. Cleveland Abbe, Washington D. C. Read by title.

25. Location of smokeless powder discharge by means of colored screens. Reginald A. Fessenden, Allegheny, Pa.

26. A method for the study of phosphorescent sulphides. Fred E. Kester, Columbus, O. *Physical Review.*

27. Accidental double refraction in colloids and crystalloids, B. V. Hill, Lincoln, Nebr. *Philosophical Magazine.*

28. Note on the age of the earth. Reginald A. Fessenden, Allegheny, Pa.

29. A bolometric study of the radiations of a black body between 600° C. and 1100° C. C. E. Mendenhall, Williamstown, Mass. *Astrophysical Journal.*

30. A bolometric study of the radiations of an absolute black body. F. A. Saunders, Haverford, Pa. *Astrophysical Journal.*

31. On thermodynamic surfaces of pressure-volume-temperature for solid, liquid and gaseous state. F. E. Nipher, St. Louis, Mo. Trans. St. Louis Acad. Sci. Read by title.

32. On the escape of gases from the planets according to the kinetic theory. S. R. Cook, Lincoln, Nebr. *Astrophysical Journal.*

33. On differential dispersion in double refracting media. E. J. Rendtorff, Lincoln, Nebr.

34. Relation of magnetization to the modulus of elasticity. J. S. Stevens, Orono, Me. *Physical Review.*

35. On flutings in the Kundt sound tube. S. R. Cook, Lincoln, Nebr. *Philosophical Magazine.*

36. Dielectric strength of oils. Thomas Gray, Terre Haute, Ind.

37. Some unexpected errors in watt-meter measurements. Terre Haute, Ind.

38. Note on the preparation of reticles. David P. Todd, Amherst, Mass Read by title.

39. The nature of spoken vowels, with reference to the theories of Helmholtz and Hermann. E. W. Scripture, New Haven, Conn. Read by title.

40. Pressure and wave-length. J. F. Mohler, Carlisle, Pa. Read by title. *Astrophysical Journal.*

41. The attenuation of sound and the constant of radiation of air. A. Wilmer Duff, Ithaca, N. Y. Read by title. *Physical Review.*

42. Optical calibration of the slit of a spectrometer. E. V. Capps, Lincoln. Nebr.

WILLIAM HALLOCK,
Secretary.

COLUMBIA UNIVERSITY.

SECTION I.—SOCIAL AND ECONOMIC SCIENCE.

SEVENTEEN papers were announced, fourteen of which were given in full and three were read by title. The address of the Vice-President, Dr. Marcus Benjamin, will be published in a subsequent number of SCIENCE.

There were four morning sessions and two afternoon sessions, and the interest was sustained till 3:30 on the last day.

The first paper was by Mr. John Hyde, of the U. S. Department of Agriculture, on 'The Relation of Indian Corn to the Wheat Problem.' Mr. Hyde traced the development of corn raising and wheat raising from their beginnings, showing that wheat had passed a maximum while corn was apparently approaching one. Though quite independent in production, the sympathetic agreement in price is remarkable. Mr. Hyde predicted a permanent foothold and an increasing demand for American corn. While the United States is admirably fitted for corn the same is true of relatively few other lands. Wheat may be sown either in the spring or fall, and in many lands. We cannot expect to control the wheat market, but we can the corn.

Miss Cora A. Benneson, a lawyer of high standing on Federal matters, gave a paper on 'Federal Guarantees for Maintaining Republican Government in the States,' in which she pointed out that the constitution guaranteed to every State in the Union a republican government without defining what this is. This power has been used in regard to disputed possession of territory, to suppress riots, etc., and the reconstruction following the Civil War, federal intervention was constantly needed, even beyond those warranted by the constitution. It is a question how far the provision of the constitution guarantees a republican form of government to territories, it depending on what is included under 'United States.'

Mr. Henry Farquhar, of the U. S. Department of Agriculture, gave a short paper on 'Calculations of population in June, 1900.' The formula employed by Mr. Farquhar was

$$\triangle p = \frac{p}{e + fp + gp^2}$$

in which p is the population shown by a United States Census. $\triangle p$ is the 'natural increase' in a decade, excluding immigration; e, f, g are constants determined from former United States Censuses, after deducting immigration figures. In all his calculations Mr. Farquhar rejected the Census of 1870 as defective. The immigration for the decade ending next June he put at 3,750,000. Expressing p in millions, and calculating the constants from different sets of data, the writer produced four separate calculations of the population, as thus shown:

	e	f	g	p in 1900
A	2.862	0.035	0.00091	73,648,000
B	2.279	0.086	0.	74,693,000
C	2.570	0.073	0.	75,679,000
D	3.350	0.000	0.0012	74,466,000

The writer preferred *C* over the others, and concluded that the next Census would show more than 75,000,000 and less than 76,000,000.

Mrs. Florence Kelley, the Corresponding Secretary of the National Consumers' League, read a thirty minute paper on

'The Power of the Consumer, Economically Considered.' The paper was well written and admirably presented. Its general conclusions were:—The consumer, at present, has the power to decide that a given article shall not be produced, by refraining unanimously from buying it; to promote the production of a given article by demanding it; to decide within certain limits the conditions under which the production of desired articles shall be carried on. The consumer has, however, hitherto done none of these things in an orderly way, except so far as coöperative buying has been practiced, and the intervention of adulteration laws and factory laws has been invoked by consumers. The power of the consumer, while potentially very great, is really slight at the present time, and increases only in proportion as consumers organize, get into direct communication with manufacturers, and inform themselves minutely with regard to the conditions of production.

Professor Mansfield Merriman presented a study of the 'Median Age of the Population of the U. S.,' showing a marked and steady increase. His results were derived from curves obtained from the Census reports. The *abscissas* of the platted points were the ages from 0 to 100 or above. The ordinates represented the summation of all the population below the ages represented by the corresponding abscissas. For example: on the curve representing the census of 1890, the ordinate at the abscissa 20, represented the number of persons enumerated in the census of 1890 whose age was *20 or less*. The curves become tangent to the lines of total population at about 104 years.

The abscissa of the point where the curve crosses the line of *half the population* marks the 'median age' since one-half of the whole people are less than that age and one-half are more than that age. In addition to the median age of all classes, the median ages of particular classes were given, as shown in the following table:

Census year.	Whites.	Native Whites.	Colored.	All Classes.
1850	18.6	——	16.5	18.3
1860	19.3	——	16.5	18.9
1870	19.9	16.2	17.7	19.6
1880	20.9	17.8	17.5	20.4
1890	21.9	18.9	17.6	21.4
1900	(22.9)	(20.0)	(17.6)	(22.4)

This indicates a steady increase in the length of life, though it does not tell what that length is.

Mr. H. T. Newcomb's paper on 'Trusts, a Study in Industrial Evolution,' was exceptionally fine in both form and substance. No brief abstract can do it justice. There was no sentiment in it, no partisan bias, but a careful and impartial statement of the growth of the various forms of combination and coöperation by both employer and employed, from partnerships through trusts to corporations; from trades unions, to the American Federation of Labor. Mr. Newcomb's paper will undoubtedly be published in some form at an early date.

Dr. Washington Gladden's paper on the 'Moral Tendencies of Existing Social Conditions' was an able discussion of the moral effects of the prevailing industrial and commercial system. Dr. Gladden is a close student of men and affairs, and his observations should have great weight. The competitive system is responsible for the tendencies whether good or ill. He enumerated the *gains* we seem to be making: 1. In common honesty. There is less of cheating and fraud in ordinary business than there were fifty years ago, though buyers are more reckless in running into debt. 2. In the development of the fiduciary virtues. Men learn to trust each other more and to deserve more confidence, notwithstanding an occasional embezzler. 3. The system enforces a valuable lesson in coöperation. Dr. Gladden believed that the big corporations

which almost control the markets, furnish better goods, edible compounds with less adulteration than formerly; and that retail buyers are less honest than retail sellers. On the other hand there were *losses* incident to the growth of the present system. 1. Men lack self-reliance and initiative. There are lessening opportunities for independent enterprise. While we learn to coöperate we lose the power to set ourselves to work. 2. The lowering of moral standards through an exaggerated popular estimate of the importance of material wealth. Against these evil tendencies there is strong resistance. The moral ideals were never more clearly held or more bravely maintained than now by teachers, preachers, writers, artists.

Probably changes in the industrial and social organization will be found needful. Doubtless the world will never be reformed by changes in the machinery of society; but doubtless the world will never be reformed without such changes. It is needful that the spirit of fellowship and coöperation be cultivated and the spirit of strife and competition be repressed.

Before Sections D and I, Mr. G. B. Morrison gave the results of experiments in heating and ventilating a model house. The paper was full of technical matters, but the grand conclusions appeared to be two in number:

1. Air, warmed to a proper temperature, should be introduced to a school room through numerous small openings in the floor throughout the room, so that the great mass of air may rise slowly and uniformly to the ceiling, and there be allowed to pass out, growing cooler as it rises.

2. Given the proper amount of air to be furnished to a crowded room, it is far cheaper to move it by fans than by an aspirating flue which requires heating for the purpose.

Mr. John S. Clark, of Boston, well known for his labors in the dissemination of works on drawing and art, read a very interesting paper on: 'Science and Art in their Relation to Social Development.' He said that scientific research to-day aims through knowledge at the solution of practical problems. Art is the product of creative activity. It is impossible to draw a sharp dividing line between industrial and fine art. Attention was then called to the relation between art on the one hand, and civilization on the other hand. He pointed out that the last century of scientific research also witnessed the development of landscape painting and of the poetry of nature. Fine art is the ultimate result of any given race or period. In art, man finds the fullest room for the exercise of his broadest powers.

A paper, by Dr. Thomas L. Balliet, 'On Some New Aspects of Educational Thought,' was one of the best of the meeting, and it commanded the closest attention and aroused the greatest enthusiasm. The discussion which followed lasted for over an hour and was participated in by Dr. Gladden, ex-President Scott, Professor C. M. Woodward and many others. It is expected that a detailed abstract of the paper will be published in Science.

In his discussion of 'The Manual Element in Education,' Professor C. M. Woodward, of the St. Louis Manual Training School, sketched the growth of the manual element from its introduction in the kindergarten, the chemical laboratory and the engineering and trade shops forty years ago, to the modern manual training school and the light tool work now introduced into the higher grades of the grammar schools. Kindergarten teachers had thus far shown their inability to extend their work into the primary school. A great wall of prejudice prevents any proper union of the first reader with the 'gifts.' But from the upper side all the grades are coming into a participation in the benefits of educational tool work and exact drawing. Every child

is entitled to a modicum of systematic manual training as a part of a rounded education.

Mr. Newcomb's paper on 'The Spoils System in Theory and Practice' was a surprisingly frank and straightforward exposition of the manner and extent to which members of Congress plunder the national treasury by creating unnecessary offices and filling them with friends who make themselves agreeable, but perform no needful public service. The paper will soon appear in print.

C. M. WOODWARD,
Secretary.

WASHINGTON UNIVERSITY.

THE AMERICAN MATHEMATICAL SOCIETY.

THE sixth summer meeting of the American Mathematical Society was held at the Ohio State University, Columbus, Ohio, on Friday and Saturday, August 25th and 26th, simultaneously with the meeting of the American Association for the Advancement of Science at that place. In attendance and range of subjects covered in the papers presented, the meeting was thoroughly representative of mathematical activity throughout the country. The President, Professor R. S. Woodward occupied the chair, and in opening the first session contrasted the present lively interest in mathematical investigation as indicated by the list of papers to be read, each of which was in some way a contribution to the sum of mathematical knowledge, with the conditions of thirty or forty years ago when the workers in mathematical science were very few and were confined within narrow limits.

The American Mathematical Society which represents the organized forces for research and the diffusion of mathematical knowledge in the United States has had a remarkable growth. It was organized upon its present basis in 1894 and now numbers over three hundred members. Ten new members were elected at this meeting and eight applications for membership were received.

The following is a list of the papers presented, many of which will be published in the *Transactions of the Society*, others in the *American Journal* or the *Annals of Mathematics:*

'Note on relative motion,' Dr. A. S. Chessin, New York, N. Y.

'On surfaces of zero relative velocity and a certain class of special solutions in the problem of four bodies,' Mr. F. R. Moulton, University of Chicago.

'On the use of generalized differentiation in the solution of physical problems,' Professor John E. Davies, University of Wisconsin.

'A new class of link works,' Professor Arnold Emch, Kansas Agricultural College.

'A relation between point and vector analysis,' Mr. Joseph V. Collins, Stevens Point, Wisconsin.

'John Speidell's 'New Logarithmes,' Professor Florian Cajori, University of Colorado.

'On analogues of the property of the orthocenter,' Herbert Richmond, M.A., King's College, Cambridge.

'A theorem on skew surfaces,' Professor C. A. Waldo, Purdue University.

'Irrational covariant conics of a plane cubic,' Professor H. S. White, Northwestern University.

'On the generalization of Desargues' theorem,' Professor Frank Morley, Haverford College.

'On certain crinkly curves,' Professor E. H. Moore, University of Chicago.

'Note on non-quaternion number systems,' Dr. Wendell M. Strong, Yale University.

'On mixed groups,' Professor H. B. Newson, University of Kansas.

'The invariant theory of the inversion group,' Dr. Edward Kasner, Columbia University.

'Note on the imprimitive substitution groups of degree fifteen and on the primitive substitution groups of degree eighteen,' Miss Emilie N. Martin, Bryn Mawr College.

'A new definition of the general abelian group,' Professor L. E. Dickson, University of Texas.

'Definition of various linear groups as groups of isomorphisms,' Professor L. E. Dickson, University of Texas.

'On the groups of cogredient isomorphisms that are abelian,' Mr. W. B. Fite, Cornell University.

'On the groups that are the direct products of

two subgroups,' Dr. G. A. Miller, Cornell University.

'A proof that there are no simple groups of order 1440, 1512, 1680 or 1800,' Dr. G. H. Ling, Wesleyan University.

'On a relation between the totality of the elliptic functions and a line complex,' Dr. H. F. Stecker, Northwestern University.

'Geometric construction of the elliptic integral of the second kind, and of the Weierstrass sigma-function,' Dr. Virgil Snyder, Cornell University.

'Some applications of elliptic functions,' Professor Alexander Pell, University of South Dakota.

'On Fresnel's wave surface,' Dr. L. T. More, University of Nebraska.

THOMAS F. HOLGATE,
Acting Secretary.

EVANSTON, ILLINOIS.

THE WORK OF FOREIGN MUSEUMS.

THE annual reports of several foreign Museums have been received during the summer months, and from them one may obtain a fair idea of the work they are doing, the support they receive and the disadvantages, mainly of lack of money and space, under which they labor. These reports comprise those of the Australian Museum (1897), Colombo Museum (1898), Museum Association of the Kingdom of Bohemia (1898), West Prussian Provincial Museum (1898), Castle Museum, Norwich (1898), Edinburgh Museum of Science and Art (1897), Corporation Museums and Art Galleries, Glasgow (1898), and Manchester Museum (1898–99). The first two institutions are government museums, the last four fall in the category of local museums, although that of Manchester, from its relations with Owens College, is on a somewhat different basis from the others. The Museum of Prag, and we believe the West Prussian Provincial Museums are, like various other European institutions, under the control of an association, although receiving a subvention from the state, to which they are responsible.

The Australian Museum leads the others in the matter of expenditures, although these only reach the sum of $35,000, and is doing much good work for the public in judiciously planned and well labeled exhibition pieces, and for science by constantly adding to its study series and publishing the results obtained therefrom. The usual complaint is made of lack of room and lack of force, but the completion of a new series of well-built and well-equipped workrooms is announced forming the basement of what will later on form a new wing to the Museum building. The most important publication was the memoir on the zoology of the Funafuti Expedition of 1896, but two parts of the 'Records' were also issued. The MS. for the two parts 'Accipitres and Striges' of the new edition of Dr. E. P. Ramsay's catalogue of birds is also ready. The number of accessions was 11,000, mostly gifts, and the number of visitors 122,894.

The Colombo Museum is practically prohibited from doing any work by the smallness of its appropriation, 24,000 rupees (about $8,000), as this does not suffice to fairly meet the running expenses, since we are told that the wood work is suffering for the lack of paint. This is to be deplored, for the Museum is well located for original work, is the official Museum of Ceylon, and is well attended by the public as is shown by the record of 111,000 visitors.

The activity of the Museum at Prag is shown by the numerous meetings of the various sections of the association by which it is controlled, while its collections have been extensively studied. The Director, Dr. Fric, gives some of the results of his studies in connection with his *Fauna der Gaskohle* and announces the completion of ten plates for that work. The expenses of the Museum amount to $24,000, a sum that

seems small in comparison with those of our own large museums; there is a special fund, *Matice Ceskā*, for the publication of scientific works in the Bohemian language, and another for the continuation of Barrande's great memoirs on the Silurian of Bohemia. There were 91,000 visitors and it is stated that of the Museum Guide Book, 555 copies in German were sold and 1,008 in Bohemian.

The report of the West Prussian Provincial Museum which, as its name indicates, is actively concerned with the history of that region including archeology, ethnology, and natural history, is mainly devoted to detailed accounts of the numerous accessions received by the different departments. These notices contain much information regarding the various objects, for example, noting the past and present range of the bear and wild boar, and describing and figuring various archeological specimens and the conditions under which they were found.

The Glasgow, Edinburgh and Norwich Castle Museums all include art galleries, and the report of the former relates to four distinct institutions. In all of these, science is necessarily more or less subordinated, playing the most important part perhaps in the Norwich Museum, and all are exhibition museums, none of them issuing any publications save guides to the collections. That of Norwich is particularly good and contains much information, especially in regard to the valuable local collection of birds. The attendance for these institutions was respectively 1,210,648; 770,807 of this being at 'The People's Palace,' 338,287 and 128,969.

The Manchester Museum is, if Mr. Hoyle will pardon the phrase, a very live Museum, and the report opens with a brief notice of the installation of the electric light. This was described at some length in the Report of the Museums Association of Great Britain, and comprises 162 incandescent and 44 arc lights, the latter of the inverted type and with the light reflected not downwards, but by means of a conical reflector upwards to the white ceiling. The most important acquisition has been the Dresser collection of birds, noticed in SCIENCE, and the most important publication, Mr. C. D. Sherborne's 'Index to the Systema Naturæ of Linnæus,' showing the place of every species name in the tenth and twelfth editions both as to genus and page. Mr. Sherborne is a believer in the 'law of priority' as applied to nomenclature and indicates his preference for making the tenth edition its starting point.

The number of gifts to these various museums, governmental or local, is noteworthy, since this is largely a test of the interest taken by the community in the welfare of the institution, but it is to be remarked that ethnological material is less freely given than any other. Finally three of the museums present us with figures bearing on the question of Sunday opening, and in each case the number of visitors on Sunday is much in excess of that on other days; thus in the Australian Museum, the average week day attendance was 341, that of Sunday 634, while in the Norwich Museum, the figures were respectively 396 and 706. At the Manchester Museum the attendance on week days ranged from 30 to 372 and on Sunday from 146 to 550.

F. A. L.

ROBERT WILHELM BUNSEN.

WITH the death of Bunsen there has passed away the last of those great German chemists of the middle of the present century, chemists who bore the greatest part of the work of laying the foundations of the modern science, and through whose efforts their fatherland has taken the first place in chemistry among the nations of the earth. The century began with Wöhler and Liebig; in the next decade came first Bunsen

and then Hofmann and Kolbe and Fresenius; perhaps to these we should add Kekulé, who followed ten years later. Wöhler brought to Germany the chemical power and intellect of the Swede Berzelius; Liebig the brilliancy of the French school, where Gay-Lussac, Vauquelin, Thénard, Dulong, Chevreul and other successors of the 'Father of Chemistry' were full of activity. Wöhler, at Göttingen, and Liebig, at Giessen, became the progenitors of the German school. Bunsen and Kolbe were Göttingen boys, Hofmann and Fresenius (and we might add Kopp) were born at Giessen, while Kekulé was a youth in Bunsen's laboratory. This band of men were not merely discoverers of chemical fact and theory; they were the discoverers of men. Hardly a chemist of note to-day in Germany or England or America, who has passed young manhood, but has felt the direct impress of one or another of these men. They have been the world's teachers of chemistry, and to-day how many teachers are using their personal recollections of these their own instructors to inspire the next generation of pupils.

And now the last of these giants is gone. Liebig was the first to be taken, just rounding out his three score years and ten. A decade later and Wöhler and Kolbe passed. The last ten years have seen the death of Hofmann, Kekulé, Fresenius and now, at the close of the century, a few months only before the hundredth anniversary of Wöhler's birth, Bunsen is dead.

The outward incident of Bunsen's life is quickly told. Robert Wilhelm Bunsen, the son of a distinguished theologian, was born at Göttingen, March 31, 1811. In 1831 he was graduated at the University of Göttingen as Ph.D., and after some study at Paris, Berlin and Vienna he was appointed *Privatdocent* and then assistant professor at Göttingen. In 1836 he succeeded Wöhler at the Polytechnic School at Cassel, and in 1838 was appointed professor of chemistry at Marburg. Here he remained for several years, went to Breslau for a short time, when he was called in 1851 to Heidelberg. Here he remained active till 1889, when he resigned from service; but he still retained all his old interest in the chemical laboratory. Sometime before resigning, he received a very urgent call to the University of Berlin, but he was unwilling to change his home in his old age. He died at Heidelberg, August 16, 1899. Few honors which fall to the lot of chemists but were bestowed upon him. In 1858 he was elected foreign member of the Royal Society; in 1883, one of the eight foreign associates of the French Academy of Sciences. He received from the Royal Society in 1860 its Copley medal, and in 1877 he and his associate Kirchhoff were joint recipients of the newly-founded Davy medal.

Bunsen was a broad chemist, confining his work to no one branch of the chemical field. He was equally at home in theory and in practice, and perhaps his most important work consisted in laying foundations on which others should erect the superstructure. He would hardly be called a prolific writer, and yet he is credited with more than a hundred articles, of most of which he was the sole author.

His first published work was in 1834 and consisted of a short note in the *Journal de Pharmacie* calling attention to the value of ferric oxid (hydrated peroxid of iron) as an antidote for arsenic poisoning. This was the beginning of his work on arsenic, from which he was to receive great reputation, but from which also he was to nearly lose his life. He could not have better shown his pluck and enthusiasm than by attacking the dangerous problem of the organic compounds of arsenic. It was a theme which has cost more than one chemist his life, but it was of great importance in Liebig's work on the 'radical theory.'

More than twenty years earlier Berzelius had said: "The application of what is known regarding the combination of the elements in inorganic nature, to the critical examination of their compounds in organic, is the key by which we may hope to arrive at true ideas with respect to the composition of organic substances." Bunsen followed up this idea, showing that the so-called *alkarsin*, $As_2(CH_3)_4$ was a radical, but a compound radical, being made up of arsenic an inorganic element combined with hydrocarbon radicals which are organic. This work of Bunsen's, though of course far less reaching in importance than Wöhler's then recent synthesis of urea, was far more difficult and dangerous, not only than this, but also than Liebig and Wöhler's investigations of the benzoyl radical and Gay-Lussac's study of the cyanogen radical. This work of these four chemists established for the time being the 'radical theory' which indeed was to be soon overthrown, but was later to reappear as a part of our theory of to-day.

At the time Bunsen was carrying on his researches on organic compounds of arsenic, he was beginning that series of investigations on the gases in the iron furnace, which culminated in the report presented to the British Association in 1845 by himself and Lord Playfair, on the 'Gases evolved from iron furnaces, with reference to the theory of smelting of iron.' While the utilization of the waste gases of the iron furnace for fuel had been attempted at a much earlier date, it was not till the work of Bunsen, alone and with Playfair, that the enormous waste in these gases was impressed upon iron-masters; so that Bunsen can be said to have largely contributed to this great source of economy in the modern furnace. In other directions also these investigations bore practical fruit.

The study of furnace gases had demanded methods of gas-analysis which at that time did not exist. Perfecting the old, originating new, Bunsen built up a system of methods of gas analysis which have remained the foundation of those subsequently used; indeed he has been called the founder of this branch of analytical chemistry.

In this connection should be mentioned the Bunsen burner, now universally used in chemical laboratories, and almost as extensively outside, as in the Welsbach light. The principle of mixing a proper amount of air with a combustible gas and burning it from an open tube is very simple—after it is known, but it was unknown until discovered by Bunsen.

In 1841 and 1842 Bunsen published his experiments on the use of carbon in the place of the more expensive platinum in the Grove battery. The outcome of this work was the Bunsen battery, which has been one of the most useful as well as the cheapest of all batteries, and which may be said to have refused to yield supremacy until displaced with all other batteries by the dynamo.

Having a powerful source of electricity at his disposal, he re-investigated the methods by which nearly fifty years before Davy had been the fortunate discoverer of so many new elements. Bunsen improved these methods, and made in connection with Matthiessen, the first thorough study of lithium, which had been discovered by Arfvedson in 1817, and for the first time the metal was isolated by him.

All through this period and for many years later he took great interest in mineralogical chemistry, especially in the chemistry of rock formation. In 1847 he visited Iceland, and soon after published a number of papers on the chemical geology of that island and also on the theory of geysers.

A series of investigations carried out with Sir Henry Roscoe, on photo-chemistry, laid the foundations of actinometry. The work of Daguerre and his followers had

just given birth to the art of photography, but the whole subject was up to this time empiric. By Bunsen and Roscoe it was placed on a scientific basis and the way blazed out for the many future investigators in this field.

One further study should be mentioned, that of Bunsen and Schischkoff on the theory of gunpowder. Gunpowder had been known for centuries; van Helmont had stated that its power was due to the production of gas, but beyond this little or nothing was known till these chemists took up the investigation of the gases formed and the powder residues, and formulated for the first time a theory of gunpowder. Here as in other cases the first incentive was given which resulted in the work of Karolyi and Abel and Nobel, and the many present-day workers in the field of explosives.

This *résumé* is but an outline of the more important work of this great chemist, during the first half century of his life. It was almost at the close of this half century that there was to come, as it were as a crown to his work, that great discovery with which the name of Bunsen will ever be most closely linked, spectrum analysis. For several years he had been interesting himself much in blow pipe analysis, and it seems probable that the key to this discovery came, not as a result of long and patient search, but rather grew from his daily work of laboratory instruction. It was the discovery of the teacher rather than of the investigator. Associating with him his colleague, Kirchhoff, together they worked out the practical application of his discovery, and science stood armed with a new weapon, the spectroscope. Bunsen was the first to avail himself of the instrument and brought forth from the waters of Dürkheim two new elements, rubidium and cesium. Later other new elements have followed, as indium discovered by Boisbaudran and thallium by Crookes, and a host of 'meta elements' differentiated only by the spectroscope, the latest of them, victorium, needing not only this instrument but also the camera, to render its 'lines' apparent.

But far more important than the mere discovery of new elements was the widening of man's horizon in a new and unexpected way. Spectrum analysis was applicable not alone to those flames we could place before it within the confines of our laboratories; the light of the sun and the stars could be studied equally well and a means was at hand for learning the chemistry of the heavenly bodies. Yet this was not all, for by the displacement of lines the motion of stars and other bodies in line of sight becomes known. Astro-physics is rendered possible by Bunsen's work.

The last of the great investigations of Bunsen were on calorimetry. The Bunsen ice calorimeter was described by him in 1870 and rendered possible specific heat determinations, with quantities hitherto too small for investigation. While from this time his activity was much lessened, yet now and then papers continued to appear from his pen. The last few years of his life, however, were spent in the quiet retirement of the old university town which had so long been his home. As long as he was able he took great delight in showing visitors over his old laboratory, and the writer will long remember a pleasant hour spent with the old man in his laboratory some years ago, how he showed the rooms and places where this or that historic work was done, and what a delightfully genial man he was to a young stranger.

As the old chemist's sun was sinking to the west there came to Heidelberg, like a brilliant meteor, one whose fame far outshone the older light. All things were changed, the old building passed, a new and magnificent laboratory took its place; again students flocked to the Neckarthal

for chemical study, but the discoverer of the spectroscope was almost forgotten. A few brief years passed by, and as the light of the brilliant meteor is suddenly extinguished, so Victor Meyer was no more. But still Bunsen lingered, as if loath that a single year of the century ushered in by his master Wöhler should be left without the presence of one of the giant minds of chemistry. But now he too is gone and the last link between the past and the present is severed as far as lives go; but upon the foundations laid by Bunsen many a superstructure will continue to rest, and yet many another building will be erected.

JAS. LEWIS HOWE.
WASHINGTON AND LEE UNIVERSITY.

SCIENTIFIC BOOKS.

Anatomie des Frosches auf Grund eigener Untersuchungen. By A. ECKER und R. WIEDERSHEIM, durchaus neu bearbeitet von DR. ERNST GAUPP. Zweite Abteilung, Zweite Hälfte. Lehre vom Gefässsystem. Braunschweig, 1899, pp. XII. and 237–548.

Some time ago (this JOURNAL, Vol. VII., p. 463) we had occasion to notice the first and second parts of Gaupp's edition of Ecker on the frog, and now the third part of the same work lies before us. This part is devoted solely to the anatomy of the vascular system and here, as in the sections devoted to the skeleton, muscles and nerves, we find what is practically a new treatment, and not merely a revision of an old work. Not only has every page been rewritten, but every illustration has been redrawn, and most of them are printed in colors, adding not a little to the clearness.

It is impossible to summarize these 312 pages nor to point out what is new in them, for that would require more space than we can give. As one would naturally expect, the additions and changes are less in the parts relating to the arteries and veins, but even here they are numerous. The heart is described with far more accuracy and detail than ever before. It is, however, in the lymph system that the changes are the greatest. In fact, this section is almost wholly a new investigation. In the former editions there was a brief account of the lymph-hearts and of some of the sub-cutaneous lymph-sacs and that was all. Dr. Gaupp has studied not only all of these (he has added four sub-cutaneous lymph sacs not recognized before), but he has described with the greatest detail the lymph spaces which are scattered through the body and has made out the openings by which they communicate with one another.

As we turn over the pages of the work we wonder what the technique has been and many may be glad to learn his methods. For injections of the arterial system he found that shellac solutions were most useful, while for the venous system he depended largely upon natural injections, the blood settling in these vessels. To aid in this the animals were hung in various positions so that the blood might flow into the various portions. Then a transfer to formalin produced coagulation. A similar coagulation of the lymph as well as the well-known method of inflation with air aided in the demonstration of the lymph sacs and spaces; while the communications between these (minute openings in the thin and almost transparent membranes) were rendered visible by means of absolute alcohol and weak solutions of iodine.

In conclusion we may say that we have only praise for this part of the work, and that, while in a few places we find differences from conditions which occur in our American frogs, we find nothing that we can regard as serious errors. The probabilities are that it will never be translated, but it is a treatise which should be on the shelves of every laboratory. The clear and simple German in which it is written will make its contents easily accessible to the great majority of our college students. The concluding part dealing with the viscera, integument and sense organs, is promised shortly.

J. S. KINGSLEY.

The Fixation, Staining and Structure of Protoplasm, a Critical Consideration of the Theory and Technique of Modern Cell-study. By DR. ALFRED FISCHER (Leipsic), royal octavo, 362 pages, 1 double plate and 21 figures in text. Published by G. Fischer, Jena, 1899.

The history of the closing cycle of botanical

activity will undoubtedly show that one of its most noticeable and unusual features has been the enormous amount of energy devoted to the study of the structure of protoplasm. Research in this phase of biological science may be said to have had its origin chiefly in an effort to determine the mechanism of the nucleus as a vehicle of heredity, and it has been directed for the greater part to the morphology of the chromatin in mitotic division, and to the behavior of the 'attractive and directive bodies,' with some effort to take into consideration the structure of protoplasm and the general organization of the cell. The results of these investigations have filled a great amount of space in all classes of botanical Journals, beside the special periodicals devoted to the subject, and have covered an untold area of the costliest plates. The early specialization of a large number of the younger workers in this line has led to the publication of many articles on the subject utterly devoid of literary form, filled with local and personal terms, uselessly recounting technique, and giving the most merciless repetition of details of observation with no attempt to summarize the results, or give the general significance of the phenomena described: making the preparation of such a work as the book under discussion doubly necessary.

Then again the time seems at hand when the cytologist may be fairly asked to interpret to his botanical brethren the vast amount of detail accumulated in the last decade by his method of research. So far as the general discussions of recent date may be taken as a reply to this pertinent inquiry, the summary of well-grounded facts and established theory shows a very small residuum of actual progress. Thus one of the most prominent cytologists in America has taken occasion to say, in a recent review of knowledge of the cell, "And yet if we take account of the actual knowledge gained, we can not repress a certain sense of disappointment, partly that microscopical research should have fallen so far short of giving the insight for which we had hoped, but still more because of the failure of the best observers to reach any unanimity in the interpretation of what is actually visible under the microscope. * * * I would like at the outset to express the opinion that, if we except certain highly specialized structures, the hope of finding in visible protoplasmic structure any approach to an understanding of its physiological activity is growing more, instead of less remote, and is giving way to a conviction that the way of progress lies rather in an appeal to the ultra-microscopical protoplasmic organization, and to the chemical processes through which this is expressed." (E. B. Wilson, in SCIENCE, p. 34, July 14, 1899.)

The chief value of the book at hand consists in its collation of the methods used, and facilitates the ready selection of those which give promise of results in new methods of attack.

In Part I. the reaction of the more important chemical constituents of the cell to fixing agents is discussed, and the principles evolved must be considered as valuable when used as a means of chemical analysis of the cell. Part II. takes up in detail the methods and theory of staining. Chromatin is defined as the substance which contains nucleic acid and which as the acid content increases, stains less deeply with watery solutions of acid colors, and methyl green is designated as the only basic stain for nuclear substance. The chapters on this subject should do much to give a more intelligent development of the technique of staining, though it is to be feared that such terms as 'acidiphobie,' 'basiphobie,' 'eosinophilie' and 'fuchsinophilie' will be transplanted bodily into the English text by that class of workers who seem unequal to the translation of new terms, or the suppression of those unnecessary to the real advance of the subject. Astral rays and polar spindles come in for their share of attention in Part III., the chief methods of forming artificial radiating processes are given. The discussion of the histology and development of these structures is notable for its omissions, which are further reflected in the bibliographical list. The consideration given centresomes illustrates quite clearly the fragmentary and contradictory state of our information concerning the morphology and physiology of these bodies.

The concluding part of the work is taken up with a consideration of the various theories as to the structure of protoplasm, an adduction of the views of most of the principal workers, and

the description of the experiments for the production of artificial protoplastic formations.

It is to be said that this book of Dr. Fischer's comes most timely to aid the beginner, or the worker in other lines of investigation to orient the vast body of detail which has been presented in such confusion during the last decade, and it may also do much to put research upon the included subjects on a more rational basis.

D. T. MACDOUGAL.

NEW YORK BOTANICAL GARDEN.

A Class-book of (Elementary) Practical Physiology. By DE BURGH BIRCH, Professor of Physiology in the Yorkshire College of the Victoria University. Philadelphia, P. Blakiston's Son & Co., 1899. Pp. xii + 273.

This book is one of that considerable class of laboratory guides which are prepared for individual laboratories. While fairly good of its kind, it cannot readily be adapted to general use. This is more particularly true of the experimental section, where the directions to the student frequently have reference to specific appliances which, in the form here described, are not to be found in physiological laboratories generally. The course outlined is that which is so commonly denominated Physiology in the British colleges, and consists of histological, chemical and experimental sections. The first section comprises 117 pages, the second 61, and the third 87. The method employed is that of supplying the student with detailed directions, leaving comparatively little opportunity for the play of his ingenuity. This method, while making instruction easy for the instructor, does not develop the student. It is carried to its extreme in dealing with the direct method of using the ophthalmoscope: "First, with the apertures closed, endeavor to look into the eye through the lens, moving your eye and a light in all directions to do so. You will not succeed." If success is impossible, why deliberately guide the student in that direction?

Not a large amount of ground is covered by the book. The subjects and experiments that are presented are the conventional ones, and the work is intelligently done. The book, however, hardly seems to be called for outside the author's own laboratory. FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

Elementary Physiology. By BENJAMIN MOORE, M.A., Professor of Physiology in the Medical Department of Yale University. New York, Longmans, Green & Co., 1899. Pp. viii + 295.

The majority of the briefer text-books of physiology are not written by physiologists. They are the work of men who rely upon larger text-books for their knowledge, and whose motive too often is the money to be obtained from the text-book mongers. Too many of these authors are willing, for a consideration, to prostitute the science for commercial purposes, and to write it down to the level of those who appear to believe that an account of the working of the human body, and a description of the awfulness of a drunkard's life, are synonymous. It is a relief and pleasure to turn from such machine-made books to such a one as Professor Moore's, and to feel the loving interest that every page of the book reveals. One can forgive the occasional lapses from strict rhetorical usage, the not infrequent long sentences, and the rather indiscriminate and often misleading use of commas, when one realizes that the author knows his subject and writes entertainingly of it.

The book is devoted to the physiology of man and those animals that are allied to man, and in less than three hundred pages there is given a concise and very readable outline of the subject, an appendix of practical exercises and a set of test questions. The trend of the author as a physiologist is evidenced by the fact that nearly one-half of the book is devoted to nutrition, including the blood and its circulation, digestion, absorption, metabolism, respiration, excretion and animal heat. In an unprejudiced division of the subject of human physiology, this seems too large a proportion, although it must be granted that the account of these processes is an admirable one. Forty-three pages seem also too large a share to give to the skeleton and its articulations. In general, the amount of anatomy may be criticised as excessive; but throughout this the author keeps in mind the subject of function and thus illuminates his descriptions of structure. Furthermore, one-sixth of the whole space is a small proportion to devote to the nervous sys-

tem and the special senses. It is to be hoped that before issuing a second edition, which will probably be called for, the author will re-apportion his space and develop more fully these latter subjects.

The book is fully up to date in its facts. As to point of view it represents, like nearly all text-books of the physiology of man, that of conventional or organ physiology, rather than that of the cell.

FREDERIC S. LEE.

COLUMBIA UNIVERSITY.

Analyses Electrolytiques. Par AD. MINET. Masson et Cie, Paris.

The first three pages of the first chapter of this little volume aim to be historical, but in the latter respect are so incomplete that they are really misleading. The subsequent pages, devoted to the sources of electricity, the measurement of current intensity, a description of the different apparatus used in electrolytic analysis and electrolytic constants, are much more satisfactory and really praiseworthy.

The second chapter pretends to consider electrolysis from a qualitative standpoint, but is so meager in its details that that feature of it would probably have better been omitted. The quantitative determination of non-metals (the halogens, nitrogen in nitrates and sulphur in sulphides) is also considered.

The third chapter relates to the quantitative determination of individual metals. In the main the procedures are similar to those already described in existing works upon electrochemical analysis. There is no good reason to omit the double cyanide of mercury and potassium in speaking of proper electrolytes for the determination of that metal. Under iron reference is made to the 'Procede de Drow,' meaning of course our own Dr. Drown. The author seems to have been careless in regard to the correctness of names, for there are numererous oversights of this character scattered throughout the entire book. At times there seems to have been an effort made to give due credit to the various workers in this particular field, but oftener there is an absolute neglect as to the origin of the methods.

Had M. Minet ever tried the separation of copper from silver electrolytically, the reviewer sincerely doubts whether he would have recommended the suggestion given on page 134. Those experienced in this direction know that to precipitate out the silver as oxalate, wash it, etc., is a vexing operation. Why not simply add an excess of alkaline cyanide to the solution of the two metals and electrolyze at 65°C? The separation is then complete and rapid. Other methods are not above criticism, but it is not the purpose of the reviewer to find fault. His sole desire is to see the best given to those who may undertake to do work in this field.

The fifth chapter gives in considerable detail the work of Hollard in the application of electrolytic methods to the analysis of alloys, and is very meritorious in every respect. One hundred and seventy-six pages comprise the entire volume, which no doubt will serve well to give one, not especially interested or conversant with this field of investigation, a very good idea of what is being done, but the writer questions whether more than that can be fairly claimed for this publication.

EDGAR F. SMITH.

BOOKS RECEIVED.

Observations taken at Dumraon Behar, India, during the Eclipse of the 22d of January, 1898. REV. V. DE CAMPIGNEULLES. New York, London and Bombay. 1899. Pp. xi + 194 and thirteen plates.

The North American Slime-Moulds. THOMAS H. MACBRIDE. New York and London, The Macmillan Company. 1899. Pp. xvii + 231 and eighteen plates. $2.25.

Social Laws, an Outline of Sociology. G. TARDE, translated by HOWARD C. WARREN. New York and London, The Macmillan Company. 1899. Pp. xi + 213.

Darwinism and Lamarckism. FREDERICK WOLLASTON HUTTON. New York and London, G. P. Putnam's Sons. 1899. Pp. x + 226.

SCIENTIFIC JOURNALS AND ARTICLES.

UNDER the administration of Dr. von Ihering, the Museum of Sao Paulo, Brazil, is accomplishing much scientific work while at the same time rapidly enlarging its study and exhibition collections. The third volume of its *Revista*, contains a posthumous paper by Dr. Fritz Mueller on the 'Marine Fauna of the Coast of Santa

Catherine,' descriptions of new Coccids, by T. D. A. Cockerell and A. Hempel, and 'Contributions to our Knowledge of the Spiders of Sao Paulo,' by W. J. Moenkhaus. A. S. Woodward describes several new fishes from the bituminous schists of Taubaté, interesting from the fact that they belong to existing genera, and Ricardo Krone gives an account of 'the Limestone Caves of Iporanga.' The major part of the volume is devoted to a systematic list of 'the Birds of Sao Paulo,' by Dr. von Ihreing, intended as a working basis for the study and discussion of the ornithology of that State. Dr. von Ihering admits 590 species. An alphabetical index of the common names is appended which should be of good service to those interested in the avifauna of Brazil. The volume closes with a bibliography of current works on natural history and anthropology relating to Brazil. Dr. von Ihering records the finding of a dead specimen of *Spheniscus magellanicus* on the coast of the island of Santo Amaro off the coast of Brazil, in about latitude 24° S. A previous example was taken still farther north at Sao Sebastiao island, 23° S.

American Chemical Journal for September, 1899, contains the following articles:

'On alkyl malonic nitriles and their derivatives,' by J. C. Hessler.

'On the phenylhydrazones of benzoin,' by A. Smith.

'Thermal effects of the dilution of some salts,' by F. P. Dunnington and T. Hoggard; 'Preservation of Hübl's reagent,' by R. Bolling; 'Dehydration of crystals of sodium phosphate,' by T. C. Whitlock and C. E Barfield.

'Examination of a Sandstone from Augusta County, Virginia,' by W. W. Miller, Jr.

'Solubility of lead sulphate in ammonium acetate,' by J. C. Long.

'Analysis of Smithsonite from Arkansas,' by W. W. Miller, Jr.

'Desulphones and ketosulphones,' by E. P. Kohler and Margaret B. MacDonald.

'The reaction between sulphone chlorides and metallic derivatives of ketonic esters,' by E. P. Kohler and Margaret B. MacDonald.

J. E. G.

The Osprey for September opens with a brief article on 'Familiar Birds of Honolulu,' by Milton S. Ray, followed by 'Eight Days Among the Birds of Northern New Hampshire,' contributed by John N. Clark, and dealing mainly with the nesting habits of the many species observed. Four short papers deal mostly with various warblers and then, under the head of Notes for 'Observation of Habits of Birds,' Ernest Seton Thompson gives a list of the points that should be particularly noted. F. H. Knowlton and W. F. Henninger contribute letters on the question of excessive egg collecting. Numerous interesting notes and reviews of current literature complete the volume.

THE only scientific and philosophical articles which appear in the October *Monist* are: (1) 'Psychology and the Ego,' by Professor C. Lloyd Morgan, Bristol, England; (2) 'The Man of Genius,' by Professor G. Sergi, Rome, Italy; and (3) 'A Decade of Philosophy in France,' by Lucien Arréat. The remainder of the contents is devoted to a discussion of the Bible, by Professor C. A. Cornill, of Breslau, Germany, Dr. W. Henry Green, of Princeton, N. J., and Dr. Paul Carus.

Appletons' Popular Science Monthly for October, completing its fifty-fifth volume, has as a frontispiece a portrait of the late William Pepper, and includes an article narrating his great activity for the public institutions of Philadelphia and especially the University of Pennsylvania. The number contains an account of the Columbus meeting of the American Association, by Professor D. S. Martin, and a number of other articles including two on the administration of charities, by Bishop Potter and Comptroller B. S. Coles.

SOCIETIES AND ACADEMIES.

THE WASHINGTON BOTANICAL CLUB.

THE eighth regular meeting was held August 2, 1899, a paper by Dr. Gerrit S. Miller, of the U. S. National Museum, on the species of *Apocynum* occurring within the District of Columbia, was presented by Mr. Pollard. Dr. Miller recognizes three new species in addition to the already known *A. androsæmifolium* L., *A. cannabinum* L., *A. medium* Greene and *A.*

album Greene. The paper was illustrated by herbarium material and by samples of the flowers of each species preserved in formalin. While the main characters lie in the shape of the calyx and corolla tube, the habit and foliage of the plant afford good diagnostic points.

Mr. O. F. Cook discussed certain new or little known species of *Amanita*, commenting on their structure and relationships.

The ninth regular meeting of the Club was held September 6, 1899, and was devoted to an informal account of the Alaskan flora by Mr. Frederick V. Coville, who was a member of the Harriman expedition.

Charles Louis Pollard,
Secretary.

DISCUSSION AND CORRESPONDENCE.

ON THE DEFINITION OF GEOLOGICAL TERRANES.

Surprising as it may seem to those who are not professional geologists, it nevertheless with truth may be said that until within the last decade or two there existed little demand for the concise definition of geological terranes and formations. The mere application of a name was almost enough to establish it. In this connection there was often also an enumeration of the common fossils contained, or a somewhat generalized vertical section of the rock layers. One or the other of these features and a knowledge of the typical locality at which the rocks were exposed often enabled the terrane to be subsequently recognized and the title to be used.

At the present time all is changed. With the systematic introduction of local geographic names for the geological terranes, and the general adoption of criteria of discrimination other than those afforded by fossils, there has come to exist an urgent need for more accurate definition of terms. The degree of accuracy now demanded is comparable to that attained in other branches of science. The requirement is for definition based not on trivial or accidental characters, but upon features that are not only really determinative, but recognizable in the field.

The classes of characteristics that require attention are not many, yet in the description of geological terranes it rarely happens that any of these features are clearly pointed out, or when mention is made of them that they are equally compared. When a new name of a rock terrane is formally proposed, about the least thing that its author can do, if he wishes his term to be considered by his fellow workers, is to tabulate the leading characteristics and differences as compared with associated terranes.

In the past there has been little or no necessity for very exact discrimation; hence in using the title suggested by the workers of a generation or more ago we have to do the best we can, giving the pioneers the benefit of all doubts. When titles are applied to terranes now there is cogent demand for formal enumeration of essential features.

Exactly what should constitute a proper definition of a geological terrane may give rise to some differences of opinion. But there should be no variance of views regarding what points should be especially mentioned. Little or no attempt has yet been made to formulate these groups of essential characteristics. They appear, however, to fall naturally under six categories, which may be termed: (1) geographic distribution, (2) topographic expression, (3) lithologic nature, (4) stratigraphic delimitation, (5) biologic definition, and (6) economic content.

1. *Geographic Distribution* is of first importance, as it fixes the terrane in space. The actual area occupied, or the amount of territory over which it forms the surface rock, is largely a function of the present attitude of the rocks. When the beds are horizontal, or nearly so, the surface distribution closely coincides with the original lateral extent. The area occupied is broad. As the degree of tilting increases, owing to orogenic movement that took place after the sediments were laid down, there is a narrowing of the zone until, when the strata stand vertically, it reaches a minimum breadth.

In the definition of a geological terrane the matter of geological distribution is not only of much greater import than it was formerly supposed to be, but it is a factor that is constantly becoming more valuable for the reason that rock units are now being named after

prominent geographic features that are situated within their borders.

2. *Topographic Expression.*—While the surface relief, or topographic expression, of various regions has received more or less consideration in the past, its great variety and characteristic types have been only vaguely connected with the structure and composition of the underlying rocks. Only recently has the interpretation of topography found a philosophical foundation. Only within the last few years has arisen a entirely new department of geological inquiry. The rapid development of this new science of geomorphy, or geographic geology, has given a new meaning to stratigraphy, and therewith has furnished a reliable criterion for determining and mapping geological formations that was wholly unthought of before. General topographic expression may be now regarded as one of the most important and distinctive attributes of geological terranes.

When its topographical type and peculiarities are clearly discerned a terrane may be, with frequent checks from other sources, traced many miles with rapidity and certainty, from horseback, or often even from the swiftly moving railway train.

As the differences in the topography of a region are dependent primarily on the relative power of resistance to erosion that the several contiguous layers possess, there is usually a close relationship existing between this feature and the other characteristics which have been heretofore generally considered alone in connection with stratigraphy. Thus, an extensive shale bed will often be worn down to a lowland plain, while the limestone or sandstone strata on either side of the belt will form ridges. The faunas in shales are usually peculiar to them, and very distinct from lithologically different beds. Again, a limestone which forms the hard member with the soft shales is, when intercalated with crystallines, itself the soft member and constitutes the valleys.

Although the same kinds of beds may produce directly the opposite phases of topographic expression, for each particular region the phase assumed is distinctive and generally extends throughout the geographical extent of the terrane.

3. *Lithologic Nature.*—In the early part of the century it was customary to regard lithological characteristics as the most important features in the recognition of geological formations. In correlating deposits more or less widely separated, this character was depended upon, to the exclusion of all others. At a later date, when other criteria were applied, the determinations which had been made upon purely lithological grounds were found to be so faulty and unreliable that the use of this feature finally came to be ignored almost altogether. Of late, the real value of the lithologic factor is beginning to be more fully appreciated. It is certainly as trustworthy as the faunal characteristics of a terrane, and, in addition, is generally of wider application.

The lithology of a geological formation, outside of the massive rocks, is largely a function of the attitude of the adjoining land areas at the time that the beds were laid down. Hence, there is a close connection between the local character of the forming strata and the position of the adjacent land as changing under the influence of diastatic movement. In noting the distinguishing characters of a terrane the lithology should receive the fullest consideration and the most careful discrimination.

4. *Stratigraphic Delimitation.*—Until very recently little attention has been paid to the exact vertical or range limits of geological terranes. In an indefinite and incidental way they have been often fixed within narrow bounds, and the local features explained for the typical locality; but farther than this most descriptions are stratigraphically inexact.

The determination of definite, easily recognizable upper and lower horizons, that are readily traceable over considerable areas, are of prime importance, not only to have a compact, natural unit, but on account of presenting reliable features for the correlation in different parts of the geologic province. The division line between terranes is not always equally distinct and prominent throughout the areal extent of the deposit, and different criteria have often to be resorted to in different parts of a province.

While the exact position of a terrane in the general geological scale is not always to be made out with exactness at first, its approxi-

mate equivalents in well-known sections may be pointed out. The exact location in the general vertical section of the region in which it lies must, of necessity, be determined sufficiently near to enable future recognition.

5. *Biologic Definition.*—The value of the fossils contained in a terrane varies greatly with the size of the succession of strata considered. The rapid replacement of faunas in local successions enables a number of zones to be made out, each of which is characterized by certain forms which predominate. From the purely paleontological standpoint this enables the strata to be subdivided in great detail. However, the real geological relations of the terranes are lost sight of almost entirely. Without going into details, there are ordinarily certain characteristic faunal or floral phases which constitute important features by which terranes may be distinguished from one another, or which, at least, greatly aid in this determination, especially when taken in connection with the criteria. Each terrane may be regarded as possessing biotic characters which should be clearly set forth.

6. *Economic Content.*—In the practical delimitation of a geological terrane, and in tracing it over a considerable area, the ore or mineral deposits of commercial value that are contained form valuable determinative factors that are rarely taken into consideration; or, at least, in the descriptions of formations little note is ordinarily made of them. While with many, if not most terranes, the contained ores are not original depositions, but are secondarily acquired long after the rocks in which they occur were laid down, they are, nevertheless, of such peculiar organization and composition that they are seldom found either in the layers above or below. Furthermore, a rock terrane may be traced for long distances by the occurrences of valuable deposits along the line of the outcrop, or it may be recognizable by these alone over broad areas in which other characters of the terrane give no evidence of its existence. In correlating exposures somewhat widely separated, it is often only through the economic contents that a reliable clue is given to their identity.

Charles R. Keyes.

ZOOLOGICAL NOTES.

The collection of birds formed by H. E. Dresser and constituting the basis for his work on the 'Birds of Europe and Monographs of the Rollers and Bee-Eaters' has been presented to the Manchester Museum, England, by a friend who wishes to remain anonymous. Something over 1,000 species are represented, by about 10,000 specimens, illustrating differences of plumage due to age, sex and locality, all carefully labelled.

Hitherto the turkey buzzard has pursued a peaceful, if malodorous existence, unharmed by the whims of fashion, but this quiet has been disturbed by the present demand for eagle feathers for ladies hats. The supply of eagles is not equal to the demand, and as Ulysses is said to have eked out the skin of the lion by using that of the fox, so dealers substitute the primaries of the turkey buzzard for those of the eagle.

The last report of the Royal Zoological Society of Amsterdam commemorates the sixtieth year of its existence and briefly reviews the more important events in its career. Besides the well-known zoological garden the society maintains a fine aquarium, zoological museum, museum of paleontology and geology, ethnographical museum, and library, a combination which affords fine facilities for scientific work. It will be remembered that Fürbinger's monumental work on the morphology of birds was among the publications of this society. The amount of food consumed by the animals is rather appalling, but the long list of members which closes the report shows the abundant resources of the Society. The 'sport mania' is deplored as being largely responsible for the extermination of large mammals, and, among other items, it is noted that no less than fourteen African elephants were born in the gardens.

F. A. L.

RECENT ZOO-PALEONTOLOGY.

Dr. Max Schlosser, of Munich, contributes to a recent number of the *Palæontographica* a very important article upon the origin of the bears. Setting aside the generally accepted hypothesis of Gaudry, that *Ursus* sprang from *Hyænarctos* and that from *Amphicyon*, he traces

the origin of the *Ursidæ* back to the Oligocene. He places *Hyænarctos*, which first appears in the Upper Miocene, as a side line which died out in the Pleistocene. The Oligocene bears are traced back to animals related to *Cynodon* in the Upper Eocene and hypothetically to *Uintacyon* of North America. This paper is of enhanced interest in connection with the recent investigations of Wortman upon the origin of the dogs, published in a recent Bulletin of the Museum of Natural History, in which *Uintacyon* also figures. One feature of Dr. Schlosser's paper is the complete adoption of the Osborn and Scott nomenclature for the cusps of the molar and premolar teeth.

DR. JAMES P. HILL, of the University of Sydney, New South Wales, has followed up his discovery of the allantoic placenta in *Perameles* by the study of the female urogenital organs in the same type. This typical bandicoot is found to differ wholly in the structure of these organs from other Marsupials. These differences sustain Dr. Hill's original interpretation of the allantois of the Marsupials as a primitive organ characteristic of the stem Marsupialia, which most types have lost. To quote from his paper: "In concluding for the present this short discussion, I would remark that the facts here briefly set forth, in my opinion, show conclusively that the condition of the genital organ in macropods—undoubtedly one of the most specialized families in living Marsupials—can in no sense be regarded as primitive, and that just in so far as the genital organs of *Perameles* depart from the prevalent Marsupial condition they in the same degree realize the more primitive type. Indeed, the urogenital organs of the *Peramelidæ* appear, so far as I am able to judge, to have retained a more archaic condition than those of any other hitherto described Australian Marsupial, a conclusion which I believe gives very material support to that view which regards the existence of an allantoic placenta in the genus *Perameles* as an extremely primitive feature in its organization.

UNDER the direction of the American Philosophical Society has just appeared a joint paper by the late Professor Baur and Dr. E. C. Case, entitled 'History of the Pelycosauria, with a description of the genus Dimetrodon Cope.' This reminds us afresh of the great loss Paleontology has sustained in this country, and in fact everywhere, in the death of Georg Baur. This memoir is a fine example of the thoroughness of his work, giving us an exhaustive review of the Permian types the world over, which are remotely related to the living genus Sphenodon. This is also by far the most thorough *résumé* of the literature relating to the order termed by Cope the Pelycosauria. The memoir concludes by an original description of the great finned-back lizard *Dimetrodon* by Dr. Case. The only regret one feels in connection with this memoir is that the critical section is obviously left incomplete, since it lacks a clear expression of the authors' views as to the ordinal classification of the Permian reptiles.

H. F. O.

INTERNATIONAL CONGRESS OF PHYSICS.

The preliminary announcement of the congress is as follows:

La Société française de physique a pris l'initiative de provoquer, à l'occasion de l'Exposition universelle de 1900, une réunion en Congrès international de toutes les personnes qui s'intéressent aux progrès de la physique. Il n'est pas besoin de faire ressortir les avantages considérables que l'on est en droit d'attendre, au profit de la science, d'une telle réunion ; jusqu'à présent des congrès spéciaux, tels que les congrès d'électricité, ont conduit à des résultats que tous les physiciens connaissent et apprécient, mais jamais encore n'a eu lieu un congrès international consacré à la Physique générale ; il est permis d'espérer que cette première réunion présentera un grand intérêt.

Un Comité d'organisation a été constitué, qui a décidé que le Congrès international de physique s'ouvrirait le *lundi 6 août 1900*, et durerait une semaine. Le Congrès sera rattaché à l'ensemble des Congrès rentrant dans l'organisation de l'Exposition universelle ; la séance d'ouverture aura lieu au Palais des Congrès.

Il n'a pas semblé au Comité que l'on dût, dès à présent, fixer d'une façon définitive le programme des travaux du Congrès ; nous avons l'honneur de vous soumettre un projet

sur lequel nous serions très heureux de recevoir vos observations.

Le programme comporterait trois parties :

1° Rapports et discussions sur des sujets en nombre limité et arrêtés à l'avance, tels que : *a*, Définition et fixation de certaines unités (pression, échelle de dureté, quantité de chaleur, grandeurs photométriques, constantes de la saccharimétrie, échelle du spectre, unités électriques on encore définies, etc.) ; *b*. Bibliographie de la physique ; *c*. Laboratoires nationaux ;

2° Visites à l'Exposition, à des laboratoires, à des ateliers ;

3° Conférences sur quelques sujets nouveaux.

La Commission d'organisation recevra avec reconnaissance toutes les observations et propositions qu'on voudra bien lui adresser, elle fixera ensuite et vous fera connaître le programme définitif des travaux.

Le prix de la carte du Congrès sera de 20 francs, elle donnera droit :

1° A la participation à tous les travaux, à toutes les assemblées, à toutes les visites qui seront organisées ;

2° A la réception du compte rendu des travaux du Congrès, aussitôt après la publication.

Lorsqu'un membre du Congrès y viendra accompagné d'une ou plusieurs personnes de sa famille, celles-ci pourront recevoir, sur demande, des cartes spéciales à un prix réduit qui sera ultérieurement fixé.

Nous vous ferons connaître en temps utile les conditions spéciales de faveur que les compagnies de transport accorderont à l'occasion de l'Exposition universelle.

Il est nécessaire que le Comité soit, dès à présent, renseigné sur le nombre probable des membres du Congrès de 1900. Nous ne croyons point cependant pouvoir vous demander si longtemps à l'avance une résolution ferme, mais nous insistons d'une manière toute particulière pour que vous ayez l'obligeance de nous renvoyer, après l'avoir affranchie et après avoir rayé l'une des deux formules, la carte postale que vous trouverez ci-incluse :

Il est probable que j'assisterai au Congrès de Paris (avec . . . personnes de ma famille).

ou :

Il n'est pas probable que j'assiste au Congrès de Paris.

Ceci ne vous engagera en rien, à aucun point de vue, ni dans un sens ni dans l'autre ; cependant les communications ultérieures ne seront adressées qu'aux personnes qui auront envoyé la première réponse.

Toutes les communications devront être adressées : á M. Ch.-Ed. Guillaume, physicien du Bureau international des poids et measures, secrétaire pour l'étranger, au *Pavillon de Breteuil, Sèvres (Seine-et-Oise)*, ou à M. Lucien Poincaré, chargé de cours à l'Université de Paris, secrétaire pour la France, 105 bis *boulevard Raspail, Paris.*

Veuillez recevoir, M. l'assurance de nos sentiments les plus dévoués.

Le Président du Comité d'organisation,
CORNU,
Membre de l'Institut.

Les Secrétaires :
CH.-ED. GUILLAUME,
au Pavillon de Breteuil, Sèvres (Seine-et-Oise) ;
LUCIEN POINCARÉ,
105 *bis*, boulevard Raspail, Paris.

P.-S.—1° Nous vous serions particulièrement reconnaissants de vouloir bien communiquer la présente circulaire à toutes les personnes qui s'intéressent à la physique.

2° Nous prions MM. les Directeurs des journaux scientifiques de vouloir bien reproduire, au moins par extraits, la présente circulaire, et nous les remercions d'avance du concours qu'ils voudront bien nous prêter.

COMMISSION D'ORGANISATION.

BUREAU.

Président :

M. CORNU (Alfred), membre de l'Institut et du Bureau des longitudes, professeur à l'Ecole polytechnique.

Vice-Président :

M. CAILLETET (Louis-Paul), membre de l'Institut.

Secrétaires.

MM. GUILLAUME, attaché au Bureau international des poids et mesures.

POINCARÉ (Lucien), chargé de cours à la Sorbonne.

MEMBRES.

MM.

Dr D'ARSONVAL (Arsène), membre de l'Institut et de l'Académie de médicine, professeur au Collège de

France, président de la Société internationale des électriciens.

Le général BASSOT, membre de l'Institut et du Bureau des longitudes, chef du service de géodésie et d'astronomie au Service géographique de l'armée.

BECQUEREL (Henri), membre de l'Institut, professeur au Muséum d'histoire naturelle.

BENOIT, directeur du Bureau international des poids et mesures.

BICHAT, professeur à la Faculté des sciences de Nancy.

BLONDLOT, professeur à la Faculté des sciences de Nancy.

CROVA, professeur à la Faculté des sciences de Montpelier.

JOUBERT (Jules), inspecteur de l'Instruction publique, membre du Comité consultatif d'électricite.

LIPPMANN (Gabriel), membre de l'Institut, professeur à la Sorbonne.

MACÉ DE LÉPINAY, professeur à la Faculté des sciences de Marseille.

MASCART (Éleuthère), membre de l'Institut, directeur du Bureau central météorologique, professeur au Collège de France.

MATHIAS, professeur à la Faculté des sciences de Toulouse.

PELLAT (Henri), professeur à la Faculté des sciences de Paris, directeur du bureau de vérification des alcoomètres au Ministère du commerce et de l'industrie.

POTIER (Alfred), membre de l'Institut, ingénieur en chef au corps des mines, professeur à l'École nationale supérieure des mines.

VIOLLE (Jules), membre de l'Institut, professeur au Conservatoire national des arts et métiers.

We are able to publish the above announcement through the courtesy of Professor Wolcott Gibbs, President of the National Academy of Sciences, to whom it was sent with the following letter:

PARIS, le 17, juillet 1899.

MONSIEUR LE PRÉSIDENT:

J'ai l'honneur de vous adresser, sous ce pli, la première circulaire relative au congrès international qui se réunira l'année prochaine à Paris, sous les auspices de la Société française de physique.

Ce congrès, qui aura lieu au plus beau moment de l'Exposition universelle, alors que d'autres réunions similaires attireront à Paris des savants du monde entier, offrira aux physiciens des sujets d'intérêt variés, et nous osons espérer qu'ils répondront très nombreux à notre appel.

A cette occasion, nous avons pris la liberté de nous addresser à vous, Monsieur le Président, pour vous prièr de vouloir bien porter notre circulaire à la connaissance de votre Académie, et d'attirer sur elle l'attention de vos Collègues.

Nous vous serions très obligés aussi, de nous indiquer la meilleure marche à suivre pour qu'aucun d'eux, parmi ceux qui s'intéressent à la physique, ne soit oublié dans les convocations. Nous pourrions, suivant vos indications, vous envoyer le nombre de circulaires que vous voudrez bien nous fixer, ou faire l'éxpédition directement aux adresses que vous nous communiquerez.

J'aurai l'honneur de vous adresser les circulaires ultérieures faisant connaître de plus près l'organisation du congrès et les questions qui y seront traitées, et au sujet desquelles votre avis nous serait dès maintenant très précieux.

Dans le cas où votre Académie enverrait des délégués au congrès, je vous serais très obligé de m'en communiquer la liste avant le 15 juillet 1900.

En vous remerciant d'avance pour le concours que vous voudrez bien nous prêter en cette circonstance, je vous prie d'agréer, Monsieur le Président, l'expression de ma considération la plus distinguée.

Pour le Comité d'organisation,

Le Secrétaire,

CH. ED. GUILLAUME.

MONSIEUR LE PRESIDENT DE L'ACADÉMIE, NATIONALE, WASHINGTON.

THE CHEMICAL COMPOSITION OF AMERICAN FOOD MATERIALS.

THE Office of Experiment Stations of the United States Department of Agriculture has recently published a Bulletin (No. 28—revised), by W. O. Atwater and A. P. Bryant, entitled 'The Chemical Composition of American Food Materials.' The introductory pages give a brief *résumé* of the history of that portion of chemistry which pertains to the analysis of foods, especially American work of this nature. The different constituents of foods are defined and discussed. The methods of cutting up meats are explained and illustrated by diagrams showing the position of the different cuts in the live and dressed animal. The larger

portion of the Bulletin is devoted to the figures showing the chemical composition of the different articles of food. As a rule only maximum, minimum and average figures are given, but in a few cases the individual analyses are quoted.

The animal foods whose composition is given include the different cuts of beef, veal, mutton and pork; fish, shellfish, etc.; poultry, game, eggs and dairy products; canned meats, soups, etc.; sausages and other manufactured products. The foods of vegetable origin include flour, meal, etc.; bread, crackers and pastry; sugar and starch; fresh and canned vegetables; pickles and condiments; fruits, fresh and preserved; and nuts. Little information has hitherto been available concerning the composition of some of these foods, for instance, nuts.

The literature of the subject has been thoroughly gone over and the present compilation is based upon over four thousand analyses. Many of these were in out-of-the-way publications not readily accessible to students of the subject.

Such a compilation is useful to specialists and also to those interested in nutrition from a more practical standpoint. With the aid of these figures it is possible to compare one food with another as a source of nutrients. The food value of any dietary may be computed if the amount of different foods consumed is determined, and by comparing the dietary with commonly accepted dietary standards its relative value may be seen. Analyses of foods have accumulated very rapidly in recent years, and it is probable that many more will be made in the near future. This Bulletin is designed to serve as a reference book until it shall be superseded by a more extended compilation.

SCIENTIFIC NOTES AND NEWS.

Charles P. Daly died on the 19th of September in his 84th year. He had served forty-two years as Judge of the Court of Common Pleas in the city of New York, and twenty-seven years as Chief Justice, his legal decisions being regarded as of the highest authority, many of them establishing precedents in questions of international importance. He had a wide sympathy and knowledge in many subjects of art, literature and science, and a memory and facility which made him friends all over the world. He had been president of the American Geographical Society for thirty-six years, and honorary member of the Geographical societies of London, Berlin and Russia. He was largely instrumental in accumulating the fine library of the American Geographical Society, and in securing the endowment for its new home near the American Museum of Natural History of which he was also a member. He and Mrs. Daly were members of the Torrey Botanical Club, which they joined expressly in order to aid in the foundation of the New York Botanical Garden. It was largely due to their wide acquaintance with prominent and intellectual men and women that the gardens were incorporated and endowed, and they were among the first and most liberal contributors. As one of the managers of the garden, Judge Daly had an active interest in its work, being always ready with advice and contributions to aid any of its enterprises. His death, following within one week that of Cornelius Vanderbilt, deprives New York of two of its most liberal citizens, and scientific institutions of friends and patrons, whose like is seldom seen.

Admiral Walker, Professor Burr, of Columbia University, Colonel Haines and Colonel Ernst, of the Isthmian Canal Commission, have been abroad during the summer studying the plans and documents of the Panama Canal, at Paris, and examining the Kiel Ship Canal. They went later to England to visit the Manchester Ship Canal, and expected to sail from Southampton for New York on September 23d. The Commission will leave New York probably about the beginning of November for Colon, and will make a careful study of the Panama, Nicaragua and other routes.

As the daily papers report in great detail, Signor Marconi with several assistants, has arrived in America. He intends to report the yacht races for the newspapers, and afterwards to conduct experiments for the War and Navy Departments.

Professor A. W. Rücker, F.R.S., will deliver an address on the occasion of the distribution of medals at the Royal College of Science, London, on October 5th.

PROFESSORS WILLIAM LIBBEY and CHARLES MCCLURE, members of the Peary Relief Expedition have returned to Princeton with valuable collections, both of vertebrates and invertebrates.

MR. W. D. HUNTER, special agent of the Division of Entomology, Department of Agriculture, has returned to Washington, after having studied the Turtle Mountain region in North Dakota and Manitoba, supposed to be a permanent breeding ground of the Rocky Mountain locust. This he found not to be the case, and he thinks that the probable breeding ground is on the Assiniboine River, north and east of Regina, a region that will be investigated next season.

ON the occasion of the centenary of the Technical Institute at Charlottenburg, which will take place on October 19th, monuments to Siemens and Krupp will be unveiled.

THE death is announced of M. Gaston Tissandier, well known as æronaut and writer on scientific topics, and founder and editor of the weekly scientific journal *La Nature*. He was 56 years of age.

WE also regret to record the deaths of Professor Theodore Elbert, the German geologist, at the age of 42 years, and of Dr. Max Barth, director of the Agricultural Station of Rufach, in Alsace, at the age of 44 years.

THE new institute, free library and Royal museum just erected at Canterbury was opened on September 11th by the mayor of that city, Alderman George Collard. The bulk of the cost is covered by a bequest of £10,000 left to the city by the late Dr. Beaney, of Melbourne, who was a native of Canterbury. The building was used as the place of reception on the occasion of the visit of the members of the British and French Associations.

IT will be remembered that sometime since, Mr. J. M. Tata, of Bombay, offered a large sum for the establishment of a scientific research institute in India. It appears that some conditions regarding a family settlement were attached, but these have now been withdrawn, and it is hoped that the government may be able to proceed with the establishment of the institute.

THE building for the German Chemical Society of Berlin, to be named Hofmannhaus, in memory of the great German chemist, is now in course of erection, and it is expected that the exterior will be finished before the winter.

MR. ANDREW CARNEGIE has given $50,000 for a free library of Dallas, Texas.

THE Texas Agricultural College and Experiment Station has been provided by the legislature with a new building that will cost $31,000, and also with a dormitory costing $24,000.

THE last session of the legislature of Utah made an appropriation of $6,000 for a State Experiment Station, which will be located in Washington county. It is to be supported entirely by State funds and will not be connected with the station at Logan.

THE *Allegemeine Wissenschaftliche Berichte* learn from Christiana that the Norwegian Störthing will appoint a commission to award the first Nobel prize for the promotion of peace. The award will be made, as we have already stated, on December 10, 1901, the anniversary of Nobel's death, and on the same day the corner-stone will be laid of the Nobel Institute at Christiana. This Institute will have the disposal of 300,000 crowns and a yearly income of 50,000 crowns. It will be devoted especially to the study of international law, and will aim to draw students and lecturers from all nations.

It appears from letters in the London *Times* that a syndicate bought up all the rooms in Dover for the weeks of the meeting of the British Association and sold them to members at extortionate rates.

A CIVIL service examination will be held on October 17th with a view to filling the position of civil and electrical engineer in the engineering department-at-large with a salary of $125 per month.

IN view of the occurrence of cases of the plague in the village of Koloboreka in the Russian Government of Astrakhan, the Prince of Oldenburg has been made President of a commission, consisting of members of the medical council and other experts which will carry out an investigation of the subject. An outbreak of the plague is also reported at Asuncion, Paraguay.

A STUDY of the effect of pressure on the preservation of milk at the Experiment Station of West Virginia University gave such encouraging results that the effect of the same agent in preserving fruits and fruit juices is being studied now while these are in season. It is yet too soon to say whether the work will lead to a practical method for preserving these materials, but it may be said, however, that samples have been prevented from fermenting for five months; also that milk has been kept for three months and meats for seven months.

UNIVERSITY AND EDUCATIONAL NEWS.

MR. EDWARD TUCK, of New York City, has given $300,000 to Dartmouth College to be used for purposes of instruction.

BY the will of Mrs. Mary D. Goddard, of Newton, Mass., $60,000 is given to Tufts College.

PRINCETON UNIVERSITY has received from Mr. Stafford Little, of Trenton, N. J., $10,000 to endow a lectureship on themes connected with public life. Ex-president Cleveland will, during the coming year, deliver the first course of lectures.

THE medical students of Bowdoin College will receive instruction during their last year at Portland, where suitable buildings are now being erected, and where they will have improved clinical facilities. After 1900 the course will be four years in length, the first two years being spent at Brunswick, and the second two years at Portland.

THE following appointments are announced at Dartmouth College: Dr. Gorden F. Hull, of Colorado College, to be assistant professor of physics; Mr. George T. Moore, assistant in Harvard University, to be instructor in botany; and H. H. Horne to be instructor in philosophy.

SAMUEL AVERY, B.Sc. and A.M. (Nebraska). and Ph.D. (Heidelberg), for some years adjunct professor of chemistry in the University of Nebraska, has accepted the professorship of chemistry in the University of Idaho. The position left vacant at Nebraska has been filled by the appointment, as instructor, of Robert Silver Hellner, B.Sc., A.M., assistant chemist in the Nebraska Experiment Station. Mr. Roscoe Wilfred Thatcher, B.Sc. (Nebraska), has been appointed successor to Mr. Hiltner.

PROMOTIONS and changes, as follows, were made this year in the force of the Zoological Department at the University of Nebraska, Lincoln: Henry B. Ward, professor; Robert H. Wolcott, adjunct professor; Albert B. Lewis, assistant instructor; Frank E. Watson, fellow and graduate assistant.

MR. PETER FIELD, fellow in mathematics in Cornell University, has been appointed professor of mathematics in Carthage College.

MR. EDWIN HAVILAND, B.S. (Swarthmore, 1895), and A.M. (Cornell, 1899), has been appointed assistant in mathematics in Swarthmore College.

PROFESSOR W. H. SQUIRES, who holds the chair of psychology and pedagogics in Hamilton College, has been given a two years' leave of absence, which he will spend in study in Germany. W. B. Elkin, Ph.D. (Cornell), Teachers College, Columbia University, has been appointed acting professor.

AT Brown University, Frederic P. Gorham, biology, Ralph W. Tower, chemical physiology, and Arthur E. Watson, physics, have been promoted to assistant professorships.

FRANK T. DANIELS, assistant professor of civil engineering, at Tufts College, has resigned.

JAMES P. C. SOUTHALL, of the University of Virginia, has been appointed instructor in physics at Hobart College; Lindsay Duncan has been made instructor in mathematics, surveying and draughting at Union College. At Smith College, Annie Lyons has been appointed assistant in zoology.

THE following appointments as instructors, at Lehigh University, have been made: Robert M. Wilson, E.E. (Cornell), Barry MacNutt M.S. (Lehigh), and J. S. Viehe, E.E. (Lehigh), to be instructors in electrical engineering; Herman Schneider, B.S. (Lehigh), to be instructor in civil engineering, and Amasa Trowbridge, Ph.B. (Sheffield Scientific School), and chief engineer, U. S. S., *Catskill*, during the late war, to be instructor in mechanical engineering.